

CT ENTEROCLYSIS VERSUS CT ENTEROGRAPHY IN THE EVALUATION OF SUSPECTED SMALL BOWEL PATHOLOGIES - A CASE SERIES

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ABSTRACT

BACKGROUND

With the advent of computed tomography (CT), CT enterography has become the investigation of choice for evaluating small bowel disorders, as it allows better visualization of the bowel wall. As a result, CT enterography is becoming the first line of modality in the evaluation of suspected bowel diseases especially those due to inflammatory pathology.¹ CT enteroclysis, on the other hand, allows better bowel distension, thus, depicting the mucosal detail, especially in Crohn's disease. This plays an important role in the clinical staging of the disease.

MATERIALS AND METHODS

CT enterography was done by administering 100 ml of mannitol (30%) mixed in 1000 ml of water per oral. CT enteroclysis was performed by placement of a 12 F Bilbao Dotter tube and administration of 10 mg of carboxy methylcellulose in 1500 ml of warm water. Both were then followed by unenhanced and contrast enhanced CT. Histopathological correlation was acquired in 10 patients.

RESULTS

In our study which included 57 patients, 30 patients underwent only CT enteroclysis and 19 patients underwent only CT enterography. The remaining 8 patients underwent both CT enteroclysis and CT enterography. A diagnosis of Crohn's disease was obtained in 4 patients and 1 patient had a duodenal diverticulum on using CT enterography alone. A diagnosis of Crohn's disease was obtained in 6 patients on using CT enteroclysis alone. A diagnosis of Crohn's disease was obtained in 3 patients when both CT enteroclysis and CT enterography was used.

CONCLUSION

It was concluded that due to its invasive nature and increased radiation dose, CT enteroclysis can preferably be used as a complementary study to CT enterography and neither could replace the other.

KEYWORDS

CT Enterography, CT Enteroclysis, Crohn's Disease, Small Bowel Obstruction.

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BACKGROUND

Radiological evaluation of small bowel includes conventional modalities like barium studies and advanced imaging

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techniques like CT and MRI. CT enterography is one such imaging modality which is non-invasive, easy to perform and allows the evaluation of bowel wall, surrounding mesentery, the mesenteric vasculature and the perienteric fat. CT enteroclysis is a hybrid technique that incorporates the methods of fluoroscopic intubation-infusion small bowel examination with that of abdominal CT.² Here, neutral contrast material is infused through a nasoenteric tube and contiguous axial images are obtained after adequate distension of the small bowel occurs. This plays an important role in the early detection of active Crohn's disease which helps the clinician in directing treatments with targeted

monoclonal antibodies.³ Its limitations are the need for special training, invasive nature of the procedure and a different set up for proper execution. The main aim of the present study is to compare the diagnostic accuracy of CT enterography and CT enteroclysis and to evaluate its impact on the radiological diagnosis of the disease.

Aim of The Study

To evaluate the role of CT enteroclysis and CT enterography in the diagnosis of small bowel pathologies.

MATERIALS AND METHODS

We have evaluated 57 patients, out of which 30 patients were male and 27 patients were female with suspected small bowel disease.

GE light speed VCT 64 slice CT scanner was used. The inclusion criteria for our study was frequent episodes of diarrhoea (>4 bouts / day), abdominal pain and clinically suspected cases of inflammatory bowel disease. The exclusion criteria included pregnancy, patients with suspected perforation, complete colonic obstruction and patients with renal failure.

Prior to CT examination, all patients underwent bowel preparation as follows: A low residue diet with ample amount of fluids is given 2 days before the procedure following which Tab Dulcolax 2 nos. was given at bedtime on the previous night. Patient was nil per oral on the day of the examination. The renal function test was done a day prior to the day of examination.

The procedure was well explained to the patient and an informed consent was obtained.

CT enteroclysis was proposed to all 57 patients as the first examination. However, due to difficulty in intubation, CT enterography was performed in 19 patients.

An IV access was established in all patients using 18-gauge cannula. Patients undergoing CT enterography were made to consume 100 ml of mannitol (30%) mixed in 1000 ml of water per oral. This is consumed in bouts of 450 ml in the first 20 minutes, followed by 225 ml at 40 and 60 minutes respectively, starting 1 hour prior to the CT scan. One minute before the CT scanning, every patient was given 1 ampule of inj Buscopan (20 mg) through intravenous route to induce transient paralysis of the small bowel (Table 1).

Oral Phase	<ul style="list-style-type: none"> ➤ 100 ml of 30% mannitol mixed in 1000 ml of water per oral 1 hour prior to CT. ➤ 20 minutes -450 ml ➤ 40 minutes -225 ml ➤ 60 minutes -225 ml
CT Phase	<ul style="list-style-type: none"> ➤ 1 ampule of inj. Buscopan. ➤ 70-80 ml of water-soluble contrast agent is infused at the rate of 4 ml/sec. ➤ Supine single-phase images acquired at 40 seconds post-intravenous contrast administration.

Table 1

Fluoroscopic Phase	<ul style="list-style-type: none"> ➤ Tip of 12 F catheter is placed in the proximal jejunum, beyond the ligament of Treitz. ➤ Balloon inflated. ➤ 10 mg of methylcellulose in 1500 ml of warm water hand infused within 10 minutes (see text).
CT Phase	<ul style="list-style-type: none"> ➤ 70-80 ml of water-soluble contrast agent is infused at the rate of 4 ml/sec. ➤ CT performed at 40 seconds delay. ➤ CT acquisition in the early portal venous phase to demonstrate mucosal enhancement. ➤ Axial and coronal images reconstructed (slice thickness 3 mm) and transferred to PACS.

Table 2

Positive oral / rectal contrast was administered to confirm the presence of entero-enteric fistulas in 3 patients. CT enteroclysis was performed in 38 patients. They underwent fluoroscopic placement of a 120 cm 12 F Bilbao Dotter tube. The ideal location of the catheter tip is in the proximal jejunum, beyond the ligament of Treitz. The patient was shifted to the CT room following which 10 mg of carboxy methylcellulose was mixed in 1500 ml of warm water and hand infused using 50 ml syringes within 10 minutes through the nasoenteric tube. The enteroclysis requirement of a hydraulic pump to maintain and adjust the rate of infusion was not used in this study. At the end of infusion, the patient underwent CT scanning. Only neutral contrast agent was used in our study (Table 2).

Unenhanced and contrast enhanced CT was performed in both the groups with the patient in supine position, extending from the diaphragm to the pubic symphysis in a single breath-hold. Contrast enhanced CT images were obtained after intravenous injection of 70-80 ml of contrast agent (Omnipaque 350, GE Healthcare, Shanghai, China) at a rate of 4 ml/ sec with a 40 second delay to initiation of CT. Axial and coronal images were reconstructed (slice thickness of 3 mm) and the images were transferred to picture archiving and communication system. Unenhanced scans were acquired to check the level of small bowel distension, to assess the bowel density and to look for any mesenteric calcifications in carcinoid tumours.

Two-dimensional image processing was performed using a computer workstation (Advanced workstation ADW 4.4, GE medical systems, Milwaukee, WI).

The radiological findings were correlated with histopathological reports / final clinical diagnosis.

The gold standard for our study is histopathology. But as histopathological reports were unavailable for many patients, we correlated our findings with the clinical diagnosis.

RESULTS

Out of the 57 patients in the study, 30 patients underwent only CT enteroclysis and 19 patients underwent only CT enterography. The remaining 8 patients underwent both CT enteroclysis and CT enterography.

In both the techniques, all patients underwent CT without any post procedure complications. All patients who underwent CT enteroclysis experienced significant discomfort.

Out of the 19 patients who underwent CT enterography, 14 patients were found to have a normal study. A diagnosis of Crohn's disease was obtained in 4 patients and 1 patient had a duodenal diverticulum.

Out of the 30 patients who underwent CT enteroclysis, a normal study was obtained in 19 patients. A diagnosis of Crohn's disease was obtained in 6 patients. Colonoscopic correlation was obtained in 2 of these patients.

Out of the 8 patients who underwent both CT enteroclysis and CT enterography, a diagnosis of Crohn's disease was obtained in 3 patients.

6 patients were diagnosed with subacute intestinal obstruction. Out of the 6 patients, 4 were secondary to adhesive bands and 2 had no specific cause. 1 patient each had features of ulcerative colitis, ileocaecal tuberculosis, mesenteric panniculitis and incisional hernia.

Histopathological correlation was acquired in 10 patients.

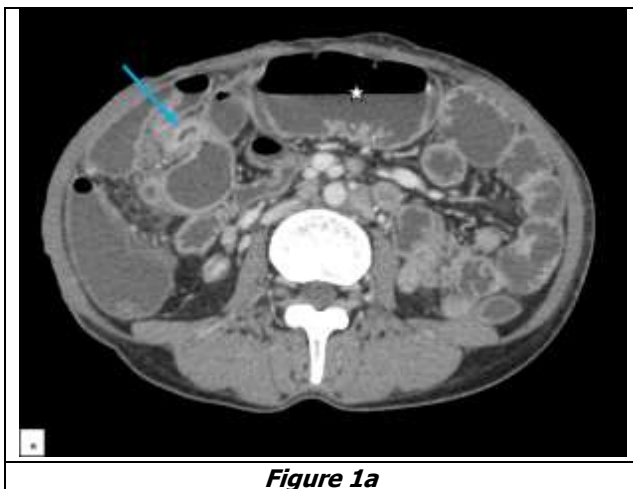


Figure 1a

Figure 1a. 34-year-old female with previous history of appendectomy presented with complaints if abdominal pain and vomiting.

- (a) CT enteroclysis axial image showing focal area of irregular wall thickening with mucosal hyperenhancement suggestive of a stricture (arrow) involving the ileal loop in the right lumbar region causing dilation of the proximal small bowel loops (star).

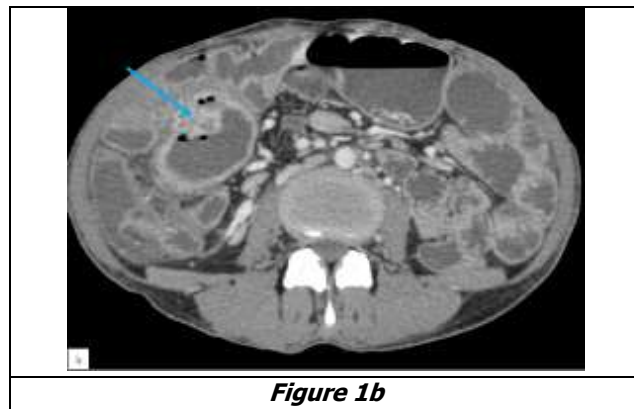


Figure 1b

- Figure 1b. CT Enteroclysis Axial Image showing Enteroenteric Fistulous Tract (Arrow) Extending from the above-Mentioned Involved Loop to the Adjacent Small Bowel Loop. Patient was Treated as a Case of Crohn's Disease.



Figure 2a

Figure 2a. 59-year-old female patient who is a known case of Crohn's disease with previous history of right hemicolectomy came with complaints of right sided abdominal pain.

- (a) CT enterography axial image showing an ill-defined collection (arrow) surrounding the distal most ileal loops and ascending colon (around anastomotic site) in the right flank region with involvement of the adjacent abdominal wall muscles.

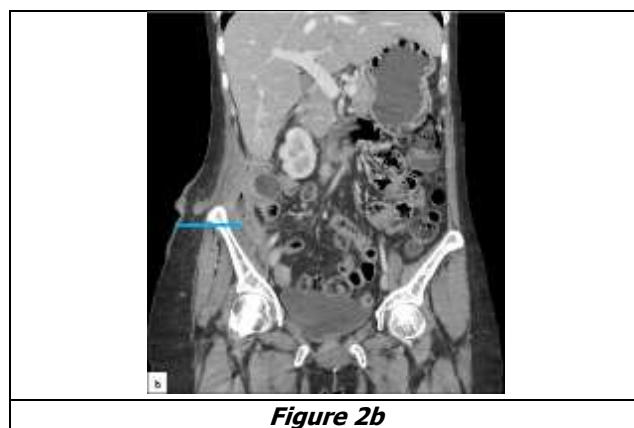


Figure 2b

Figure 2b. CT enteroclysis coronal image showing short segment wall thickening (arrow) involving the colon in the right iliac fossa.

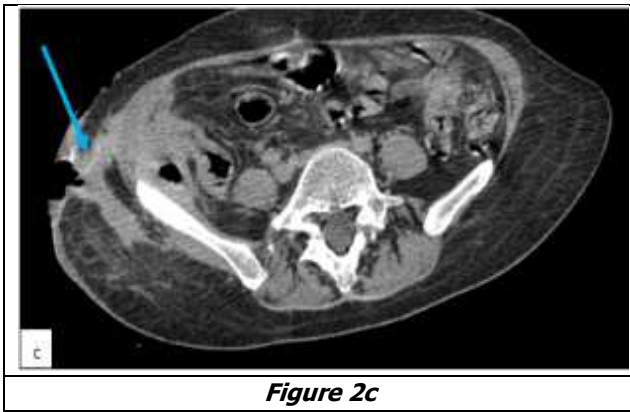


Figure 2c

➤ **Figure 2c.** Axial image showing a fistulous tract from the collections which is seen extending up the skin surface (arrow).

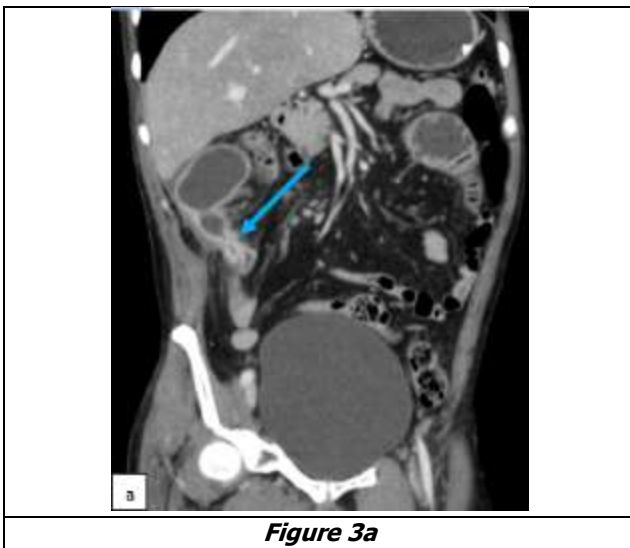


Figure 3a

Figure 3a. 48-year-old male patient presented with complaints of abdominal pain for two months.

➤ CT Enteroclysis Coronal image showing abrupt transition of one of the loop with acute angulation (arrow) in proximal jejunal loop. exploratory laparotomy with adhesiolysis was performed.



Figure 4a. 31-year-old male patient came with complaints of frequent episodes of vomiting on and off.

➤ CT Enterography axial image showing normal proximal jejunum (star).



Figure 4b and 4c

Figure 4b and 4c. CT enteroclysis coronal and axial image showing oedematous proximal jejunum, just distal to the duodeno jejunal flexure (arrow). The bowel loops show mucosal hyperenhancement with preserved mural stratification. This was a biopsy proven case of crohn's disease.

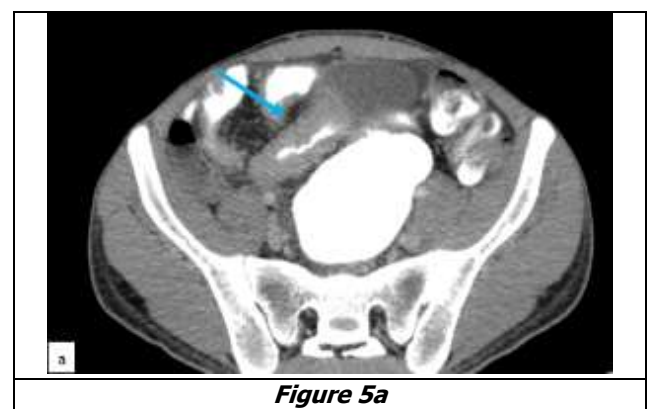


Figure 5a

Figure 5a. 26-year-old male patient with suspected ileocecal tuberculosis.

➤ CT enterography with rectal contrast axial image showing long segment wall thickening involving the distal segment of the ileum with loss of mural wall stratification and mucosal hyperenhancement (arrow).

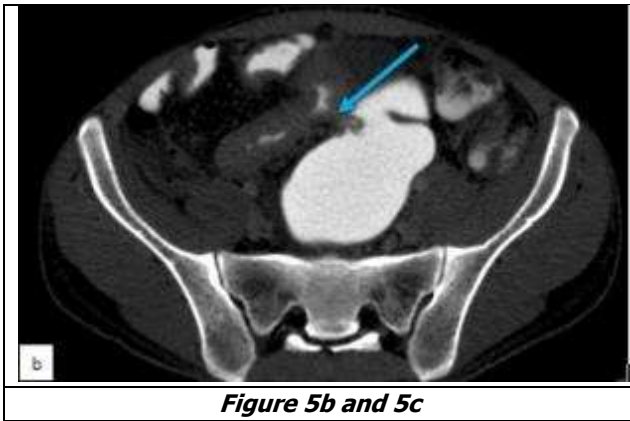


Figure 5b and 5c

Figure 5b and 5c. a Fistulous tract was demonstrated between the sigmoid colon and the distal ileal loop (arrow). this was a biopsy proven case of Crohn's disease.

DISCUSSION

CT is the most important modality in the evaluation of patients with suspected small bowel pathologies. CT is not only helpful in the visualization of the entire bowel but also helps in the assessment of the wall enhancement pattern and bowel distension. Adequate distension of the bowel loops is required to assess the degree of bowel wall thickening or hyperenhancement, which is the hallmark of intestinal disease.⁴

Water as an oral enteric contrast agent is ideal as it is cheap and well tolerated by the patients. However, due to its rapid absorption, it produces poor luminal distension. In our study, mannitol was used as it has the same density as water and is not absorbed in the intestine.

Crohn's Disease

Crohn's disease is an idiopathic inflammatory bowel disease predominantly affecting the terminal ileum and cecum. It presents with chronic diarrhoea and recurrent abdominal pain. CT enterography is useful to identify the presence and define the extent of active inflammation, differentiate inflammatory from fibrotic strictures and identify obstruction.⁵ This is due to better visualization of the small bowel mucosa via adequate distension. Mural hyperenhancement defined as segmental attenuation greater than adjacent small-bowel loops and mural thickening defined as small bowel wall thickness more than 3 mm are the most sensitive CT findings for active inflammatory Crohn's disease. It can also depict extra-intestinal complications of Crohn's disease such as engorged vasa recta (comb sign), lymphadenopathy, sinus tracts, fistulae, and abscess formation (figure 1).

CT enteroclysis was found to be very useful in the detection of low-grade small bowel obstructions, intestinal fistulas and abscess formation, which could be missed by the routine CT protocols. Enterocutaneous fistula was seen in 1 patient, which was missed out on CT enterography (figure 2). It can be used as a screening tool prior to capsule endoscopy in patients with suspected obstruction, as obstruction is a contraindication for capsule endoscopy.

Other features of inflammatory bowel disease such as sacroiliitis, renal stones, cholelithiasis and primary sclerosing cholangitis could be equally identified by both the techniques.

As CT enterography can result in collapsed jejunal loops, and hence, CT enteroclysis is used to further investigate nonspecific findings in the jejunum (figure 4). Jejunal wall thickening was overlooked in 1 patient on CT enterography owing to unsatisfactory distension, which was later picked on CT enteroclysis.

This is consistent with a study by L M Minordi et al in 2011 who concluded that distension of the proximal and distal jejunum was significantly better in patients studied with CT enteroclysis than those studied with CT enterography.⁴

Small Bowel Obstruction

Adhesions form an important cause of small bowel obstruction. It can be classified as parietal and visceral. Parietal type extends from the bowel to the peritoneal surface, usually to anterior peritoneum. Visceral type extends from the small bowel to other small-bowel loops or to adjacent organs such as colon.

In a study by Marian Kołodziej et al in 2010, it was shown that CT enteroclysis allows better assessment of the adhesion of the small intestine to the peritoneal cavity wall, bending of the intestinal loops and asymmetric thickening of the intestinal wall particularly the mesenteric border.⁶ This was well demonstrated in 4 out of the 6 patients with intestinal obstruction (figure 3).

Non-obstructive adhesions are known to cause chronic abdominal pain. Many of these patients are managed conservatively.

Ileocecal Tuberculosis

Gastrointestinal tuberculosis commonly affects the ileocaecal area (approximately 90% in case of gastrointestinal TB).⁷ Ileocecal tuberculosis is characterized by short segment mural thickening without stratification and incompetent ileocaecal valve. Associated necrotic lymph nodes and strictures may also be seen (figure 5). In our study, 1 patient was diagnosed with ileocaecal tuberculosis. Our study showed that due to better distension of the small bowel loops in CT enteroclysis, the bowel wall was better outlined and hence, even subtle bowel wall thickening could be identified. We experienced difficulty in appreciating the pathological bowel wall thickening in CT enterography due to inadequate distension. This showed that CT enteroclysis was superior to CT enterography in depicting strictures in the terminal ileum. The patient underwent ileal resection and anastomosis followed by a course of anti-tuberculous therapy.

The limitations of our study were due to the time consuming and invasive nature of CT enteroclysis, and higher radiation dose to the patient as mentioned in the literature. Cumulative exposure exceeding 75 mSv has been found to increase mortality due to all cancers by 7.3%.⁸

CONCLUSION

- Although CT enterography is widely used worldwide to assess various small bowel pathologies, CT enteroclysis has an upper edge in the detection of fistulas in Crohn's disease and strictures in patients with ileocaecal tuberculosis.
- CT enteroclysis is a valuable tool in the assessment of jejunal pathologies due to better luminal distension as compared to CT enterography.
- CT enteroclysis can supplement capsule endoscopy and can also be used when the latter is contraindicated.
- Hence, CT enteroclysis can be used as a complementary study in patients with suspected small bowel pathologies.

Abbreviations

CT- Computed Tomography.

MRI- Magnetic Resonance Imaging.

F- French.

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