Original Article

DOI: 10.7860/IJARS/2016/23917:2287

Radiology Section

# Efficacy of CT Enteroclysis in Small Bowel Disorders: A Prospective Study

ANAND SHRIKANT GAJAKOS, JYOTI TAPADIA

## ABSTRACT

**Introduction:** CT-Enteroclysis (CT-E) is a method of examining the small intestine which combines the advantage of enteral volume challenge with those of cross sectional imaging and multiplanar reformatting to improve detection of intra and extra intestinal manifestation of small bowel disease. This technique attempts to overcome the individual shortcomings of routine CT.

**Aim:** To determine site/level/cause of the obstruction in patients, clinically suspected of Sub-Acute Intestinal Obstruction (SAIO), to determine extent (length) of small bowel disease, to evaluate small bowel in case of unexplained anemia with gastrointestinal bleeding and abdominal pain, and to confirm the diagnosis of small bowel tuberculosis.

**Materials and Methods:** In this prospective study 50 patients who were above the age of 12 years both male and female referred from Surgery/Medicine/Gynaecology OPD of ARMCH&RC, with suspicion of small bowel pathology were evaluated by CT-E.

**Results:** Out of fifty patients, six patients were normal. Tuberculosis (20) was the most common detected pathology followed by sub-acute intestinal obstruction (12). The sensitivity of CT-E for the detection of small bowel tuberculosis was found to be 95.23% and specificity was 100%. Positive predictive value was 100% and negative predictive value was 96.66%.

**Conclusion:** CT-E is a rapid, well tolerated and reliable imaging modality for demonstration of small bowel pathology. CT-E helps in diagnosing small bowel pathologies such as inflammatory diseases with their intra and extra intestinal manifestations, benign and malignant neoplasms; and helps in their staging, mechanical low grade intestinal obstruction.

**Keywords:** Abdominal TB, Benign and malignant neoplasms, Bowel pathology, Intestinal obstruction

## INTRODUCTION

The small intestine which accounts for about 75% of the entire length of the gastrointestinal tract, remains the most challenging segment of the alimentary canal for diagnostic evaluation due to its length, caliber, and overlap of loops within the peritoneal cavity. Barium enteroclysis has been the most reliable radiographic examination, for the diagnosis of intraluminal bowel lesions. Although barium enteroclysis is reliable for the diagnosis of most small bowel abnormalities, this technique has limitations, including high radiation dose and indirect information about the status of the bowel wall. Also, the extraintestinal organs are not directly visible and the procedure is mostly operator dependent. Abdominal CT-scan displays extra intestinal manifestations of small bowel disease but conventional CT-scan with administration of oral contrast material has a major limitation of poor distention of bowel in many patients. Endoscopic evaluation shows promise for study of distal and proximal small bowel loops but needs placement of endoscope under general anesthesia. Thus in addition to being invasive, it cannot explore the small bowel completely [1,2].

CT-Enteroclysis (CT-E) is a method of examining the small intestine which combines the advantage of enteral volume challenge with those of cross sectional imaging and multiplanar reformatting to improve detection of intra and extra intestinal manifestation of small bowel disease. This technique attempts to overcome the individual shortcomings of routine CT and conventional barium enteroclysis to provide an investigation that is highly sensitive for many common small bowel disorders. According to literature, CT-E is defined as small bowel distension by giving a high volume negative, positive or neutral contrast media through a nasojejunal catheter followed by axial CT acquisition with multiplanar reformatting [3-8].

## OBJECTIVES

1) To determine site/level/cause of the obstruction in patients, clinically suspected of SAIO.

2) To determine extent (length) of small bowel disease.

3) To evaluate small bowel in case of unexplained anaemia with gastrointestinal bleeding and abdominal pain.

4) To confirm diagnosis of small bowel tuberculosis.

5) To determine the sensitivity, specificity, accuracy, positive predictive value and negative predictive value.

## MATERIALS AND METHODS

The study was conducted in the Department of Radiology at Ashwini Rural Medical College, Kumbhari, Solapur, India, which spanned over a period of 12 months from April 2015-April 2016, 50 patients above the age of 12 years with suspicion of small bowel pathology, predominantly pain in abdomen and subacute or recurrent intestinal obstruction were prospectively evaluated by CT-E.

All patients were above the age of 12 years of both gender (male and female) referred from Surgery OPD, Medicine OPD and Gynaecology OPD of Department of Radiology with suspicion of small bowel pathology were included in the study and patients with general contraindications for helical CT and those who refused to undergo procedure and give consent were excluded from the study.

### Materials and machines

(1) Philips "brilliance" 64 slice spiral CT scanner.

(2) Philips "optimus" digital image intensifier with television facility.

(3) Frekatube 120 cm CH/FR 12 polyurethane nasojejunal tube, with radiopaque guide wire and fixation tape.

(4) Non ionic water soluble contrast media: Iohexol (omnipaque 300 mg I/mL, 60 mL).

(5) Negative contrast media: water at room temperature.

**Position of the patient:** All the patients were scanned in the supine position with the patient's arms above their heads. These patients were positioned head- first and the movement of the table was in 'Feed in' direction. Topogram of the patient was taken to assess small bowel dilatation. This was taken in all patients to plan the field of interest to be scanned. The lower lung bases, abdomen and pelvis were included . The length of the scout coverage was 768 mm.

Images were obtained from dome of diaphragm to the symphysis pubis in a cranio-caudal direction

**Image acquisition:** CT-E was performed with Philips "64" slice helical CT scanner.

**Patient preparation:** Whenever possible a non-residue liquid diet should be given the day before the enteroclysis study. The patient should be NBM (Nil by mouth) after midnight; this includes no smoking or chewing gum.

**The insertion of enteroclysis (Naso-jejunal) catheter:** Informed written consent of the patient is taken. After the procedure has been explained and the patient's medical history reviewed, the patient's throat is sprayed with 4% lignocaine spray. To allow the guide wire to slide without resistance, the enteroclysis catheter is flushed with water which lubricates the catheter.

Sedation, even conscious sedation is usually not recommended because the patient needs to be able to communicate, move into different positions as requested on the fluoroscopy table. The operator should determine if one nostril is easier for the patient to breathe through, and then administer 2% xylocaine jelly to lubricate the nostril 5-10 cc is usually sufficient. The patient is made to sniff the xylocaine into the nostril for maximum effect of the drug and 2% xylocaine jelly is placed on the tip of the enteroclysis catheter to lubricate it, this process will decrease the resistance in the patient's nostril. Water at room temperature is infused using 50cc syringes @ of 150 – 200 mL/min. The initial dose of water infused should be slow so as to prevent bowel loops from going into ileus. The total quantity of water infused must be less than 2000 ml in all patients. 2 mL i.v buscopan is then administered to the patient to reduce the motion artifact caused by the peristalsis of small bowel. Patients are then transferred to the CT-scan table. Ethical clearance was obtained from institutional ethical committee.

## RESULTS

In the present study CT-E was relatively easy to perform and well tolerated in all 50 patients. Two patients complained of abdominal pain and vomiting post-procedure, which subsided on its own. The patients experienced no side effects from the intravenous administration of non-ionic contrast media iohexol 'omnipaque' the nasojejunal intubation was also well tolerated by all patients.

| Symptoms | Number of patients | Percentage |
|---|---|---|
| Abdominal pain | 50 | 100% |
| Loss of weight/appetite | 32 | 64% |
| Vomiting | 28 | 56% |
| Fever | 25 | 50% |
| P/H/O Pulmonary/ Abdominal.Koch's | 12 | 24% |
| Constipation | 10 | 20% |
| Diarrhoea | 5 | 10% |
| GI bleeding | 3 | 6% |

**[Table/Fig-1]:** Patient's symptoms.

None of the patient had any acute symptoms, their ailment ranged from 3-12 months except for two cases of sub acute intestinal obstruction who experienced abdominal pain and vomiting for the 1st time in last seven days [Table/Fig-1].

**Pathological distribution:** Out of fifty patients, six patients were normal. Tuberculosis (20) was the most common detected pathology followed by sub-acute intestinal obstruction (12), crohn's disease (5), neoplasms (3), ischaemic bowel disease (2) and others (2).

**Abdominal tuberculosis:** Twenty patients (40%) were diagnosed as abdominal tuberculosis on CT-E. Imaging features included bowel wall thickening, strictures, abdominal lymphadenopathy, ascites and peritoneal involvement.

Wall thickening was most common finding in abdominal TB followed by lymphadenopathy and strictures [Table/Fig-2].

The sensitivity of CT-E for detection of small bowel tuberculosis was found to be 95.23% and specificity was 100%. Positive predictive value was 100% and negative predictive value was 96.66%.

| CT-E Findings | No. of Patients | Percentage |
|---|---|---|
| Wall thickening | 16 | 80% |
| Lymphadenopathy | 08 | 40% |
| Ascites | 07 | 35% |
| Strictures | 04 | 20% |
| Peritoneal involvement | 03 | 15% |

**[Table/Fig-2]:** Imaging features in abdominal tuberculosis.

**Small bowel obstruction:** Twelve patients presented with features of sub acute intestinal obstruction. None of the patients included in this study presented with any acute symptoms.

Out of six patients with adhesions, three patients had visceral adhesions, two had parietal adhesions and one patient had a combination of both. Out of the four patients with strictures, two were tuberculous in origin, one due to Crohn's disease and one due to peritoneal seeded metastasis involving the ileal loops in a case of Ca ovary, while GIST was causing obstruction in one case [Table/Fig-3-11].

| | Disease Present | Disease Absent |
|---|---|---|
| CT-E Positive | 20 | 00 |
| CT-E Negative | 01 | 29 |

**[Table/Fig-3]:** Efficacy of CT-E for detection of small bowel tuberculosis.

| | Obstruction Present | Obstruction Absent |
|---|---|---|
| CT-E Positive | 12 | 00 |
| CT-E Negative | 00 | 38 |

**[Table/Fig-4]:** Efficacy of CT-E for detection of intestinal obstruction.

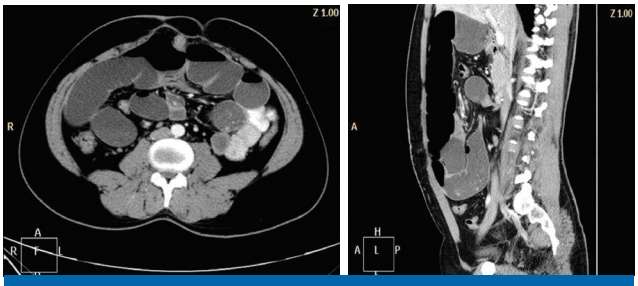
| Causes of Obstruction | No. of Patients |
|---|---|
| Adhesions | 06 |
| Strictures | 04 |
| Neoplasm | 01 |
| Ileal Diverticulum | 01 |

**[Table/Fig-5]:** Causes of small bowel obstruction.

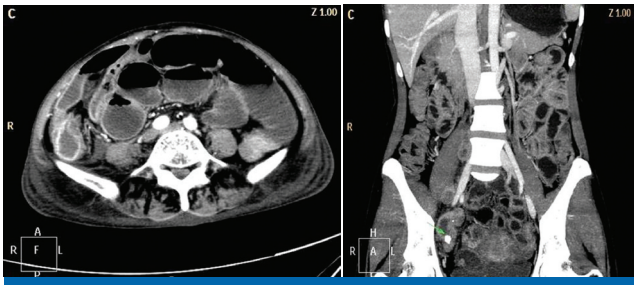
## DISCUSSION

In our prospective study, 50 patients having signs and symptoms related to small bowel pathology were evaluated with CT-E. Tthe most common finding on CT-E was bowel wall thickening seen in twenty-five patients (50%) followed by bowel dilatation in twelve patients (24%). The most common diagnosis was abdominal tuberculosis, which is seen in twenty patients (40%), followed by SAIO in twelve patients (24%). Five were diagnosed as Crohn's diseases (10%), were further classified by the subtype on CT-E findings. Three patients were detected as having small bowel neoplasm (6%). Two were interpreted as ischaemic bowel disease (4%), one with superior mesentry artery syndrome (2%) and one with a foreign body in terminal ileum causing inflammation (2%). Atherosclerotic changes in the abdominal aorta, were noted in four patients within the age group of 50-80 years (8%).

The diagnosis was confirmed by surgery, histopathology and clinical follow-up. Four patients were diagnosed with stricture. Out of four, two patients had multiple strictures involving jejunum and ileum, all underwent surgery (resection



**[Table/Fig-6a,b]:** Images showing benign jejunal stricture.



**[Table/Fig-7]:** Crohn`s disease affecting terminal ileum and caecum (left). **[Table/Fig-8]:** Foreign body in terminal Ileum (right).


**[Table/Fig-9]:** Ileal metastatic deposits in ovarian malignancy. **[Table/Fig-10]:** Ileocecal Koch`s. **[Table/Fig-11]:** Jejunal angiodysplasia (images from left & right).

anastomosis) for the same. Two of them were confirmed as of tubercular in origin, one as crohn's and the fourth due to peritoneal seeded metastasis involving the ileal loops in a case of Ca ovary.

Of five patients diagnosed as crohn's disease, one (fibrostenotic type) underwent resection anastomosis whereas four (active inflammatory subtype) were treated with higher dose of steroids and anti-inflammatory drugs and the symptoms subsided.

Three patients were diagnosed as small bowel tumors (6%). All underwent surgery. Based on CT-E findings one was diagnosed as Gastrointestinal Stromal Tumour (GIST) (2%), one as adenocarcinoma (2%) and other was diagnosed as angiodysplasia (2%).

**Abdominal Tuberculosis:** In a study conducted by Boudiaf M et al., [3], CT-E was performed in 107 patients who presented with symptoms related to small bowel disease. They had reported tuberculosis in two patients owing to the low incidence of tuberculosis in the west. Most of the study conducted in the west was focused on the utility of CT-E in evaluating Crohn's disease due to high incidence of the disease. None of the study focused on the role of CT-E in abdominal tuberculosis.

Out of the total evaluated cases we found abdominal tuberculosis as the most common pathology 20 cases (40%) as an important cause of abdominal morbidity in the Indian clinical setting, with findings of adhesions ,enlarged nodes, ascites, terminal ileal thickening, peritoneal involvement.

**Small Bowel Neoplasm and Metastasis:** The well-distended and intravenous contrast-enhanced small bowel wall provided by CT-enteroclysis with neutral enteral opacification allows detection and differentiation between extra, intramural and luminal lesions, which is of particular importance for neoplastic diseases. The local extention of the tumour, adenopathy and distant metastasis can be identified simultaneously thus CT-E aids in tumour detection and staging with a single study [8]. CT-E allows optimal depiction of serosal and extra-intestinal disease, while at the same time achieving a very high sensitivity for detecting low grade small bowel obstruction [5,6,8].

Orjollet-Lecoanet C et al., carried out CT-E in fifty patients with suspicion of small bowel tumour. They found that, the method is more sensitive and less invasive than enteroscopy. The tumour characterisations and staging can be done using a single examination [9].

In our study three patients were diagnosed as having small bowel tumours. Based on CT-E findings, they were diagnosed as one case each of Gastrointestinal Stromal Tumour (GIST), adenocarcinoma and angiodysplasia. The patient of GIST presented with low grade obstruction.

Our study fulfills these criteria (sensitivity 100% and negative predictive value 100%). In our study specificity is found to be 97.37%. Specificity increases with the increasing size of the lesions.

Chronic obscured GI bleeding or anaemia: Kaltenbach T et al., [10] conducted the study of CT-E and found Meckel`s diverticulum as one of the important cause of obscured GI bleed. We found one case (2%) of jejunal angiodysplasia, as a cause of chronic gastrointestinal bleed.

**Small Bowel Obstruction:** Bender GN et al., [11] stated the sensitivity and specificity (89% and 100%, respectively) of CT-E was higher than that of conventional CT (50% and 94%, respectively) in patients suspected of having partial small bowel obstruction. According to Zhang LH et al., [12] single or multiple points of obstruction are readily demonstrated similar to barium enteroclysis but their precise location is made easier with CT-E.

In our study, the sensitivity, specificity, positive predictive value and negative predictive value of CT-E for detecting small bowel obstruction (low grade) were found to be 100%.

## LIMITATION

a) Cost of examination and radiation exposure is greater than in the conventional enteroclysis.

b) The need for nasointestinal intubation.

c) Difficulty in performing CT when fluoroscopy unit is away from CT Department.

d) The diagnosis and assessment of motility disorders is difficult in contrast to conventional studies. All patients with predominantly functional disorders therefore should continue to be investigated with conventional enteroclysis.

e) CT-E cannot be used as a screening or first line investigation, in search for superficial mucosal alteration due to early inflammatory bowel disease which may be responsible for obscured gastrointestinal bleeding.

## CONCLUSION

CT-E is a rapid, well tolerated and reliable imaging modality for the demonstration of small bowel pathology. CT-E helps in diagnosing small bowel pathologies such as: Inflammatory diseases with their intra and extra intestinal manifestations, benign and malignant neoplasms; and helps in their staging, mechanical low grade intestinal obstruction, unexplained GI bleeding, anaemia and infections. In our study sensitivity and specificity of CT-E for detecting various small bowel pathologies was very high. Several minor drawbacks still need to be overcome like difficulties in insertion of nasojejunal tube, cost, technical problems related to image acquisition and radiation exposure. Compared to single slice CT scanners, the use of multichannel CT results in improved image quality and allows for multiplanar reformatting with higher spatial resolution. Reviewing reformatted images is essential in every CT-E case, as small bowel abnormalities may not be apparent on one plane alone. The combination of the volume challenge of enteroclysis, cross-sectional display, multiplanar reformatting, and the use of multifunctional nasointestinal catheters make CT-E not only a feasible means of non invasively evaluating the small bowel pathologies but also as a technique with documented clinical utility.

## REFERENCES


[1] Halil A, Etlik O, Kayan M, Harman M, Tuncer Y, Temizoz O. Peroral CT Enterography with lactulose solution : preliminary observations. AJR Am J Roentgenol. 2005;185(5):1173-79.

[2] Arciero CA, Bender GN, Shriver CD. Utility of Computed tomographic enteroclysis for the general surgeon. Curr Surg. 2001;58(2):205-08.

[3] Boudiaf M, Jaff A, Soyer P, Bouhnik Y, Hamzi L, Rymer R. Small-bowel diseases: prospective evaluation of multi-detector row helical CT enteroclysis in 107 consecutive patients. Radiology 2004;233(2):338-41.

[4] Maglinte DDT, Sandrasegaran K, Lappas JC, Chiorean M. CT enteroclysis. Radiology. 2007;245:661-71.

[5] Kermarrec E, Barbary C, Corby S, Beot S, Laurent V, Regent D. CT enteroclysis: a pictorial essay. J Radiol. 2007;88(2):235-50.

[6] Lappas J, Heitkamp DE, Maglinte DD. Current status of CT enteroclysis. Crit Rev Comput Tomogr. 2003;44(3):145-49.

[7] La Seta F, Buccellato A, Tese. L, Biscaldi E, Rollandi GA, Barbiera F, et al. Multidetector-row CT enteroclysis: indications and clinical applications. Review Radiol Med (Torino). 2006;111(2):141-58.

[8] Maglinte DD, Bender GN, Heitkamp DE, Lappas JC, Kelvin FM. Multidetector-row helical CT enteroclysis. Radiol Clin North Am. 2003;41(2):249-56.

[9] Orjollet-Lecoanet C, Menard Y, Martins A, Combe-Ternamian A, Cotton F, Valette PJ. CT-enteroclysis for detection of small bowel tumors. J Radiol. 2000;81(6):618-27.

[10] Kaltenbach T, Nguyen C, Lau J, Garland A, Owens S, Shumacker L, et al. Multidetector CT enteroclysis localized a Meckel's diverticulum in a case of obscure GI bleeding. Gastrointest Endosc. 2006;64(3):441-42.

[11] Bender GN, Maglinte DD, Kloppel VR, Timmons JH. CT enteroclysis: a superfluous diagnostic procedure or valuable when investigating small-bowel disease? AJR Am J Roentgenol. 1999; 172(2):373-78.

[12] Zhang LH, Zhang SZ, Hu IIJ, Gao M, Zhang M, Cao Q, Zhang QW. Multi detector CT enterography with iso-osmotic mannitol as oral contrast for detecting small bowel disease. World J Gastroenterol. 2005;11(15):2324-29.



**AUTHOR(S):**

1. Dr. Anand Shrikant Gajakos
2. Dr. Jyoti Tapadia

**PARTICULARS OF CONTRIBUTORS:**

1. Assistant Professor, Department of Radiology, Ashwini Rural Medical College and Research Centre, Kumbhari, Solapur, Maharashtra, India.
2. Associate Professor, Department of Radiology, Ashwini Rural Medical College and Research Centre, Kumbhari, Solapur, Maharashtra, India.

**NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:**

Dr. Anand Shrikant Gajakos,
Assistant Professor, Department of Radiology,
Ashwini Rural Medical College and Research Centre,
Kumbhari, Solapur-413006, Maharastra, India.
E-mail: drgajakos@gmail.com



**FINANCIAL OR OTHER COMPETING INTERESTS:** None.

Date of Publishing: **Jul 01, 2017**