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Role of computed tomography enteroclysis in the evaluation of small bowel diseases

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ABSTRACT

Background: Examining small bowel loops within the peritoneal cavity poses significant challenges because of their length and overlapping nature. **Aims and Objectives:** This study aimed to evaluate the utility of computed tomography enteroclysis (CTE) in diagnosing small intestinal diseases and to understand its clinical application. **Materials and Methods:** The study was conducted from November 2019 to October 2021 in 30 patients undergoing CTE treatment. The day before treatment, bowel preparation included a low-residue diet, lots of fluids, an overnight fast of 8–12 h, and laxatives. A 16-slice Aquilion Lightning computed tomography (CT) scanner was used in general hospitals, and a 128-slice GE Healthcare helical CT scanner was used in multispecialty hospitals.**Results:** Among the 30 patients, 20 (66.7%) were male, and 10 (33.3%) were female, predominantly aged between 30 and 60 years old. Positive findings were noted in 23 patients (76.7%), including intestinal tuberculosis, inflammatory bowel disease, small bowel obstruction, and neoplastic lesions. Various small intestinal pathologies, such as non-specific edema, intussusception, and ischemic bowel disease, were also identified. **Conclusion:** This raises the standard of current small bowel imaging by delivering suitable intestinal distension using the enteral volume challenge principle and helps identify and characterize small-bowel problems.

Key words: Small bowel diseases; Enteroclysis; Alimentary tract; Fluoroscopy; Gastroenterology

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INTRODUCTION

Inspecting small bowel loops, which are long and have overlapping loops within the peritoneal cavity, is the most challenging component of examining the alimentary tract. Barium enteroclysis provides higher diagnostic reliability and accuracy, with the caveat of reduced patient tolerance and invasiveness. Conventional barium is the most frequently used method because it is affordable, simple, and readily available. All small intestine fluoroscopic investigations have the drawback of only revealing information concerning extraluminal symptoms in patients with small bowel disease, which is clinically relevant. Our knowledge of computed tomography (CT) has allowed us to overcome this.[1,2]

CT enteroclysis (CTE) has become a more practical and effective method of examination than traditional fluoroscopic techniques for evaluating small bowel loops owing to the advantages of enteral volume challenge and the potential of cross-sectional imaging and reformation techniques to detect extraluminal manifestations of small bowel disease with faster speed of examination after reconstruction.[3] Small intestinal disorders are unclear for clinicians, making them challenging to diagnose and treat. CTE has become a viable and beneficial approach to assessing small bowel illnesses because of the multislice CT's capacity to image greater volumes faster and perform reformation and reconstruction of pictures after inspection to detect the extraintestinal manifestations of the disease.[4-6] We have assessed the role of CTE in patients who have clinical symptoms and are suspected of having small intestinal diseases, as well as to gain knowledge of how CTE is used in clinical practice.

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Aims and objectives

This study aimed to evaluate the utility of CTE in the diagnosis of small intestinal diseases and to understand its clinical application.

MATERIALS AND METHODS

This cross-sectional study was conducted in collaboration with the Department of Medical Gastroenterology at the Government Tirunelveli Medical College's Department of Radiodiagnosis, a tertiary care facility, for 2 years, from November 2019 to October 2021. Our scientific advisory group gave the study their OK and the Ethical Committee approved it.

Thirty patients aged between 20 and 65 years old were recruited using the inclusion and exclusion criteria. A sample group of 30 individuals referred to the Department of Radiodiagnosis with clinical suspicion of small bowel disease was chosen for the study.

Inclusion criteria

Patients suspected of having small bowel diseases such as inflammatory bowel disease, small intestinal tuberculosis, malabsorption, enteroenteral fistula, small bowel tumors, low-grade small bowel obstruction, and unexplained abdominal pain with a previous history of abdominal surgery were included.

Exclusion criteria

Patients with a clinical history suggestive of perforation peritonitis, acute intestinal obstruction, history of allergy to contrast, contraindications for contrast CT, and acute or chronic kidney disease/pregnancy/hemodynamically unstable patients were excluded.

Methods

The patients were subjected to CTE treatment after providing informed consent from the chosen patient population. The day before treatment, bowel preparation included a low-residue diet, lots of fluids, an overnight fast of 8–12 h, and laxatives. Premedication was administered through intravenous administration of 10 mg metoclopramide 1 h before the procedure to simplify transnasal intubation and enable quicker contrast infusion rates. An initial scout view was obtained, and CT planning was completed. Approximately 1.5–2 L of positive contrast (omnipaque/iohexol) or negative contrast (water) was infused at 100–150 mL/min. The nasoenteric tube (Bilbao Dotter catheter, 14 Fr, and 155 cm length) was positioned in the duodenojejunal flexure under fluoroscopic guidance.

Before the patient was transferred to the CT table, a 20 mg buscopan injection was administered. After the patient was moved to the CT table, 40 mL of intravenous contrast medium was administered. A 16-slice Aquilion Lightning CT scanner was used in general hospitals, and a 128-slice GE Healthcare helical CT scanner was used in multispecialty hospitals. Images were taken using a 3-mm collimation and then reconstructed using a 1-mm resolution for analysis. Images were volumetrically captured with slices that were 5-mm thick, and the images were reconstructed at 2 mm. The soft-tissue window was used for image analysis, with window levels of 40 HU and 400 HU for the window width. Subsequently, reformatted images of the axial, sagittal, and coronal planes were examined. The results and surgical, histological, and clinical follow-up data were compared.

Statistical analysis

All data were entered into MS Excel, and the demographic data were expressed as frequencies and percentages. CTE and abnormality distribution are represented as pie charts and figures.

RESULTS

Of the 30 patients, 20 (66.7%) were male and 10 (33.3%) were female. Small bowel illnesses were the reason for referral. The age group of 30–60 years was the most prevalent, followed by those aged 20–30 years. The average age of the patients who presented with symptoms of small bowel illnesses was 44 years (Table 1).

Positive results were obtained in 23 (76.7%) and negative results in 7 (23.3%) out of 30 patients (Figure 1).

Of the 23 abnormal cases, four cases of intestinal tuberculosis, five cases of inflammatory bowel disease, three cases of low-grade small bowel obstruction, three cases of neoplastic lesions, one case of enterocutaneous fistula, two cases of large bowel disease, and one case of malabsorption were identified. Four cases were found to have various small intestinal pathologies, such as non-specific edema of the intestinal wall, transitory intussusceptions, and ischemic small bowel illness. The detected abnormalities are shown in Figures 2-10.

Table 1: Patients with gender- and age-wise distribution

Gender	Frequency	Percentage
Male	20	66.7
Female	10	33.3
Age group		
20–30 years	6	20
31–60 years	21	70
61–80 years	3	10

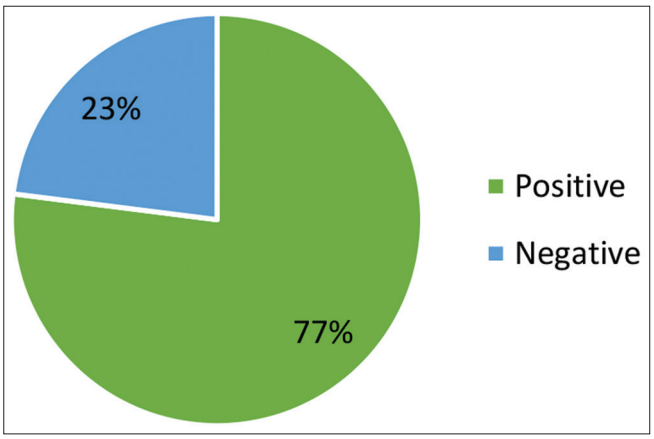

Figure 1: Patient distribution with positive and negative results

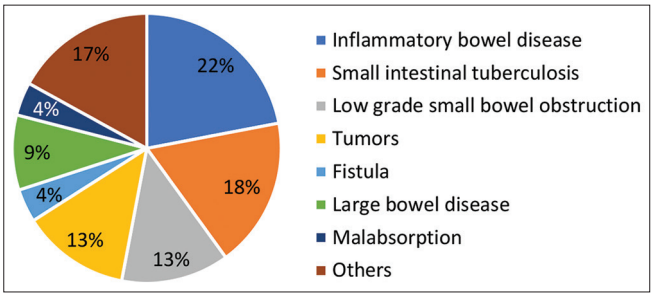

Figure 2: Patient distribution with abnormalities detected

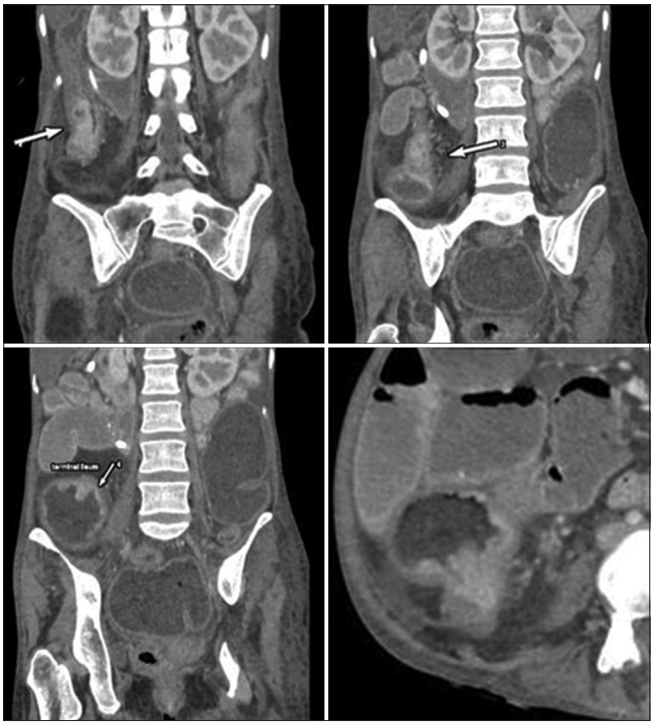

Figure 3: Multidetector computed tomography enteroclysis-enteroclysis in a 36-year-old female patient who presented with chronic diarrhea on and off for the past months showed bowel wall thickening with mucosal enhancement in the terminal ileum. An irregular polypoidal lesion showing contrast enhancement was noted in the ileocecal region and cecum, causing low-grade small bowel obstruction with prominent mesenteric vasculature

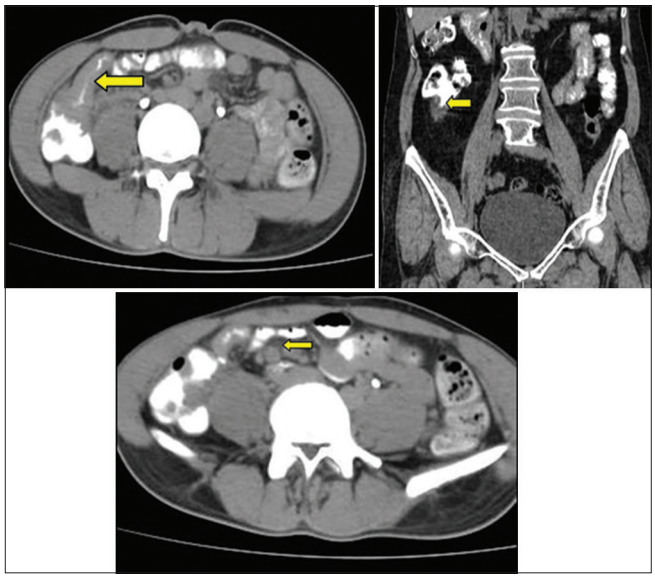

Figure 4: Multidetector computed tomography enteroclysis-enteroclysis in a year-old male patient showing terminal ileal wall thickening with pulled-up cecum and few enlarged mesenteric nodes

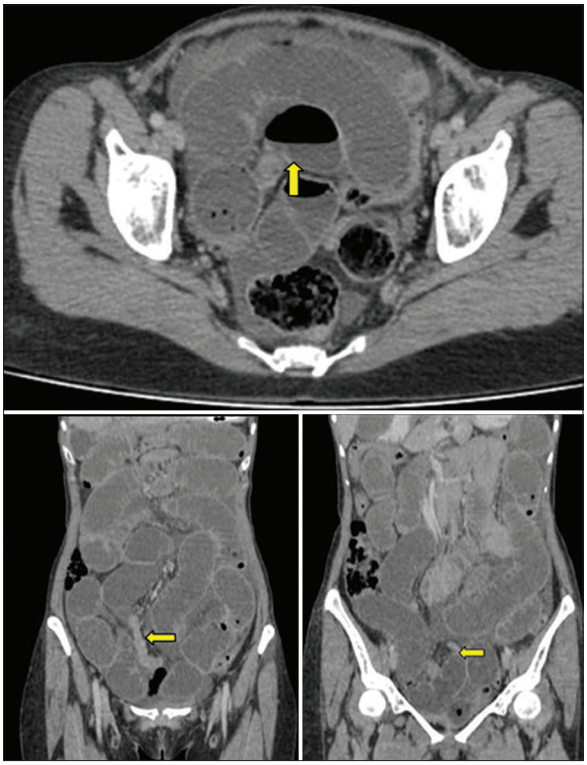

Figure 5: Multidetector computed tomography enteroclysis-enteroclysis in a 49-year-old female patient showed dilated small bowel loops with a transition point at approximately 15 cm from the ileocecal junction with the collapse of the distal ileal loop

DISCUSSION

In our study, CTE was 100% sensitive for the diagnosis of small bowel diseases, such as inflammatory bowel disease (n=5), small intestinal tuberculosis (n=4), low-

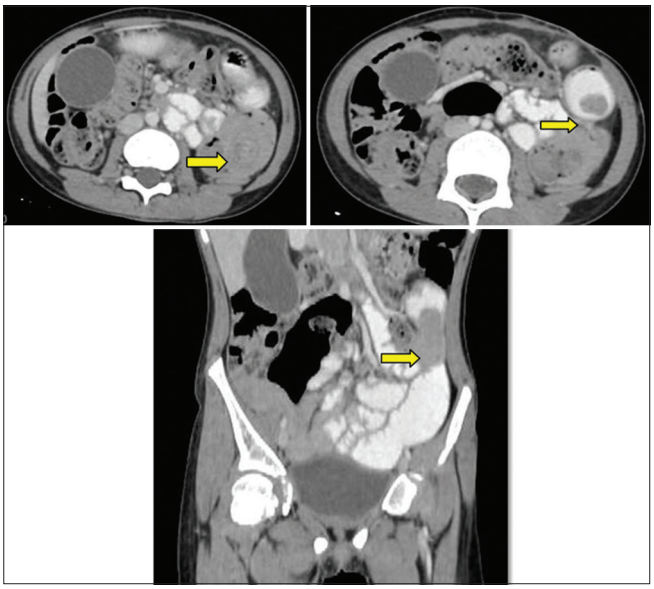

Figure 6: Multidetector computed tomography-enteroclysis in a 21-year-old patient showing jejunojejunal intussusception in the proximal jejunum. Axial and coronal images show a well-defined intraluminal soft-tissue dense polypoidal lesion noted in the mid-jejunum with a small bowel feces sign proximal to the lesion

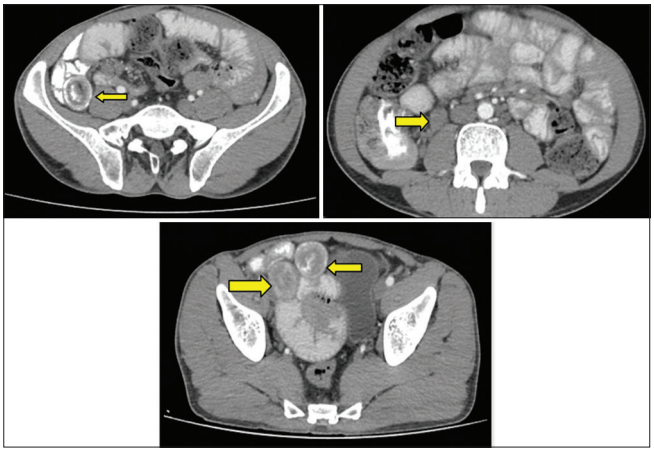

Figure 7: Axial sections of multidetector computed tomography enteroclysis in a 30-year-old male patient presenting with vague abdominal pain showing bowel within bowel appearance in the bowel loops visualized in the right iliac fossa and pelvis, suggestive of non-specific multifocal transient ileoileal intussusceptions and few enlarged mesenteric nodes in the right iliac fossa

grade small bowel obstruction (n=3), tumors (n=3), benign hamartomatous polyps (n=1), adenocarcinoma (n=1), jejunal lymphoma (n=1), enterocutaneous fistula (n=1), malabsorption (n=1), large bowel disease (n=2), and other pathologies (n=4). Two cases were identified with vascular diseases of the small bowel, and two cases were found to have non-specific transitory small intestinal intussusceptions. In one of the five Crohn's disease cases, CTE revealed thickening of the bowel wall with mucosal enhancement in the terminal ileum and an irregular polypoidal lesion with contrast enhancement in the ileocecal

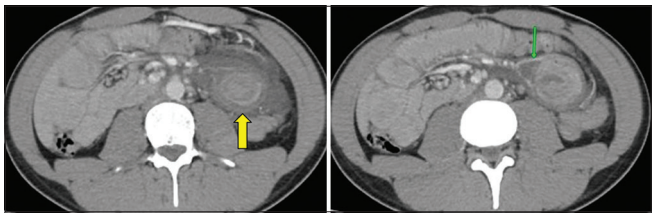

Figure 8: Multidetector computed tomography-enteroclysis in a 25-year-old male patient who had a known case of Henoch scanline purpura on treatment with recurrence presenting with complaints of intermittent abdominal pain, maroon-colored stools for 2 weeks, and rashes involving both lower limbs showed mural stratification and bowel wall edema with surrounding free fluid and prominent vascularity in the jejunum. These features suggest angioedema of the jejunum due to vasculitis

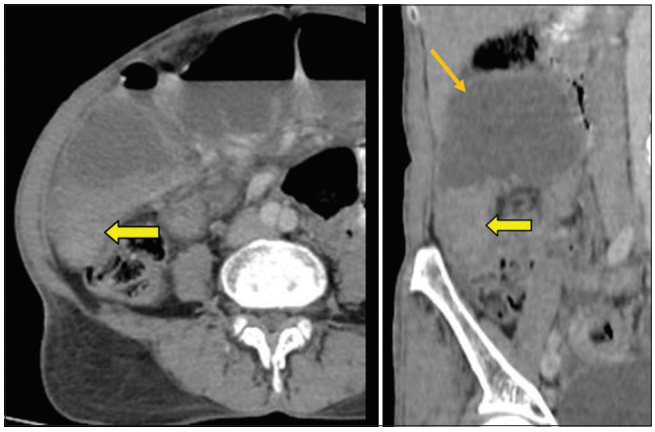

Figure 9: Multidetector computed tomography enteroclysis in a 65-year-old male patient presenting with a clinical history of dull aching abdominal pain and constipation showed short-segment irregular bowel wall thickening in the ileum at approximately 10 cm from the ileocecal junction causing low-grade obstruction with proximal dilatation of the small bowel loops. histopathological examination of the lesion was suggestive of ileal adenocarcinoma

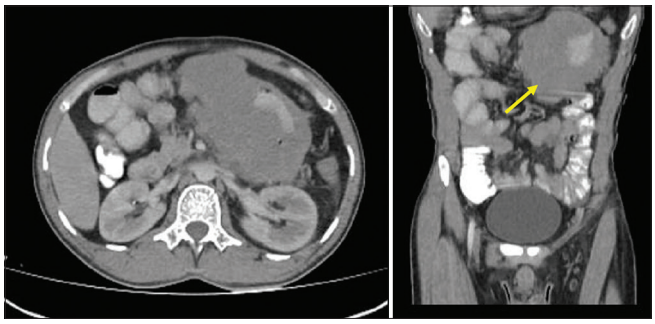

Figure 10: Multidetector computed tomography-enteroclysis in a 33-year-old male patient with a history of abdominal distension and dull-aching vague abdominal pain shows massive irregular bowel wall thickening of approximately 54-mm maximum thickness accompanied by luminal dilatation for a length of approximately 12 cm. Histopathological examination revealed jejunal lymphoma

region and cecum, both of which caused low-grade small bowel obstruction with prominent mesenteric vasculature.

The following features were identified in four individuals with intestinal tuberculosis: enlarged necrotic para-aortic

nodes and mesenteric nodes, terminal ileal wall thickening with mesenteric inflammatory alterations, and asymmetric bowel wall thickening of the cecum and ascending colon with a pull-up cecum. Ileocecal tuberculosis was differentiated from Crohn's disease by the following features: Ileocecal tuberculosis, asymmetric irregular bowel wall thickening, no creeping fat, omental and peritoneal thickening, and enlarged lymph nodes with necrotic features. Crohn's disease shows circumferential bowel wall thickening with/without mural stratification. Creeping fat (abnormal quantity of mesenteric fat) and enlarged mesenteric nodes were observed in the normal omentum and peritoneum.

The diagnostic efficacy of different cross-sectional imaging modalities, including CTE, in the early stages of Crohn's remains debatable. CTE values in the middle or advanced stages of Crohn's are well known. The degree of small intestine wall thickening and level of mucosal enhancement correlate well with disease activity during the acute or quiescent phase due to homogeneous luminal distension. Compared to traditional CT, CTE enables a better study of the small intestinal wall, resulting in a more precise and thorough diagnosis of the various pathological enhancing patterns.[7-9]

Mural stratification with mucosa is substantially contrast-enhanced and encircled by low-density submucosa, which is characteristic of acute inflammation. When clinical quiescence occurs, which is characterized by diffuse parietal contrast enhancement and modest intestinal wall thickening, chronic involvement is linked to permanent transmural fibrosis. Compared to standard barium tests, CTE simultaneously shows extraintestinal symptoms of Crohn's disease, such as inflammatory alterations in the nearby mesentery, abscesses, enteric fistulae, or involvement of other organs.[10,11] Multiplanar reformatting views can accurately show intestinal fistulous tracts, which conventional barium tests only sporadically exhibit. Even mild segmental luminal constriction caused by Crohn's disease in the active phase with enteral volume challenge can be observed using CTE. However, these changes manifest as collapsed small-bowel loops on standard CT. The length of the strictures can be more clearly established and is frequently best determined on the coronal plane with multiplanar reformations.[12-14]

CTE determined the location, degree, and etiology of obstruction in three individuals with low-grade small intestinal obstruction. Two patients experienced adhesions and one patient had a jejunal stricture. CTE showed visceral peritoneal adhesion between the ileal loops and parietal adhesions in the case of adhesions, where there was no mass or mural thickening in the transition point zone. In one case, CTE showed that the jejunum was stenotic, with pre-stenotic dilated loops and compressed distal loops suggesting jejunal stricture. The small bowel feces sign, which on a CT scan shows a mixture of particulate matter and gas bubbles within the small bowel similar to the colon, was observed in pre-stenotic dilated loops. This is because stasis increases the time needed for fluid to be absorbed across the gut wall and causes the transit of bowel contents to be delayed, resulting in the accumulation of undigested food. Bowel loop dilatation of >2.5 cm in diameter is required to diagnose the small-bowel feces sign. A dysfunctional ileocecal valve that allows bacteria to overgrow and reflux into the terminal ileum may also be considered.

In three patients with tumors, CTE revealed one case with a well-defined intraluminal soft-tissue dense polypoidal lesion in the mid-jejunum and a small bowel feces sign close to the lesion, which was later determined to be a benign hamartomatous polyp. In addition, the proximal jejunum showed signs of jejunojejunal intussusception and a few other small polyps in the small intestine. One patient showed proximal small-bowel loop dilatation and ileum cancer approximately 10 cm from the ileocecal junction. One patient's jejunal lymphoma diagnosis included substantial long-segment irregular gut wall thickening and luminal dilatation. An uncommon autosomal dominant disorder known as Peutz–Jeghers syndrome is characterized by numerous hamartomatous small bowel polyposis, which is most frequently present in the jejunum, ileum, and duodenum and is associated with an elevated risk of intestinal adenocarcinoma and non-gastrointestinal cancers. On multidetector computed tomography(MDCT) or magnetic resonance imaging, hamartomas appear smooth, homogenously enhancing intraluminal masses in the small intestine.[15]

About 25–40% of primary malignant small-intestine neoplasms are small bowel adenocarcinomas, which typically develop in the proximal jejunum or distal duodenum. Adenocarcinoma predisposes to polyposis syndromes, Crohn's disease, and celiac disease (CD), among other conditions.[16] On CT imaging, the lesion is seen as an eccentric or circumferential irregular enhancing mass with a luminal constriction that may cause small intestinal obstruction. Vascular invasion, distant metastasis (typically to the liver), lymph node metastasis, and peritoneal metastasis are possible additional findings. Approximately 20% of all small intestinal neoplasms are small bowel lymphomas. Primary gastrointestinal lymphoma, which most frequently affects the small intestine and stomach, is the most prevalent extranodal form of lymphoma. While it typically affects the ileocecal region in children and young adults, the distal ileum is the site of tumor growth

in adults. Most small bowel lymphomas are non-Hodgkin's lymphomas, and they all originate from B cells, whereas those that complicate CD are T cell-based. Pseudo-aneurysmal, polypoid, endoexoenteric, stenosing, and mesenteric forms of lymphoma were the most prevalent, and pseudo-aneurysmal was found in our case. The risk factors for lymphoma include chemotherapy, AIDS, systemic lupus erythematosus, celiac illness, and Crohn's disease.[17]

In a patient with clinical signs of malabsorption, CTE showed increased mucosal folds and extended segmental intestinal wall thickening in the proximal jejunum and mid-ileum. CTE in CD aims to detect complications including ulcerative jejunoileitis, lymphoma, and jejunal adenocarcinoma. Enteroclysis can support or disprove CD diagnosis of CD in patients with unusual symptoms. We found that CTE was the least accurate method for identifying the origin of upper gastrointestinal bleeding (UGI). In a patient with UGI hemorrhage, CTE revealed no obvious abnormalities in the proximal jejunum despite enteroscopy results that point to small bowel angioectasia.

The study has certain limitations; notwithstanding its diagnostic accuracy, the primary barrier to the widespread use of enteroclysis is the discomfort and agony experienced during nasoenteric intubation. Smaller catheters lessen discomfort, but the small catheters on the market lack a balloon attachment to stop reflux. Therefore, the use of a 13Fr enteroclysis catheter with a balloon attachment is suggested. Conscious sedation allows patients to tolerate intubation without endangering their cardiovascular health or their capacity to respond to verbal cues. Most people only need an amnesic and local nasal esthetic. Preparing interventional radiology sections and radiology nurses specifically assigned to the treatment is necessary before beginning a conscious sedation program.

Enteroclysis performance pitfalls are more closely tied to experience and knowledge with catheters, balloons, and pumps, catheterization techniques, infusion rates, and the type of modification to be employed based on clinical indications. A common misconception about enteroclysis is that it entails placing the nasoenteric tube and injecting a contrast medium to evaluate the small bowel loops. Because every patient is unique, it is necessary to understand the fundamentals of enteroclysis to optimize the protocol for each procedure modification depending on the clinical indication and address many technical aspects. To better comprehend and carry out enteroclysis, the first observation of a practice that regularly conducts these procedures regularly for 2–3 days would be beneficial.

Limitations of the study

Limitations of this study include a small sample size, cross-sectional design limiting causal inference, potential selection bias, and lack of a control group.

CONCLUSION

CTE raises the standard of current small-bowel imaging by delivering suitable intestinal distension using the principle of enteral volume challenge. We can decrease patient discomfort during intubation using conscious sedation and a smaller nasoenteric catheter. It helps identify and characterize small bowel problems, making it appropriate to compare MDCT enteroclysis to other small bowel imaging techniques. Radiologists should be familiar with the concept and procedure to fully benefit from the advantages of using CTE as an imaging modality in clinical settings.

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