ORIGINAL RESEARCH

Role of Multidetector Row CT Enterography in Evaluating the Spectrum of Small Bowel Pathologies

[1]Ankit Prabhakar, [2]Shivani Sharma, [3]Sajjad Ahmad Dar, [4]Shaafiya Ashraf

[1]Department of Radiology, GMC Srinagar, Jammu and Kashmir, India
[2]Department of Obs & Gynae, GMC Jammu, Jammu and Kashmir, India
[3]HOD & Professor, [4]Associate Professor, Department of Radiology, GMC Srinagar, Jammu and Kashmir, India

Corresponding Author
Shivani Sharma
Department of Obs & Gynae, GMC Jammu, Jammu and Kashmir, India
Email: doctorshivaniraina@gmail.com

Received: 03 July, 2023 Acceptance: 07 August, 2023

ABSTRACT

Background: The pathological processes occurring in the small bowel are seen in a number of patients attending hospital, irrespective of their age and sex.The present study was conducted to assess the outcomes of CT enterography in patients with small bowel diseases. **Materials & Methods:** 214 patients who presented with different small bowel pathologies referred by the Gastroenterology department and other departments of Government Medical College were selected. In all the CT enterography scans were performed with helical CT scanner – FOURTH GENERATION 256 SLICE CT SOMATOM DEFINITION AS FLASH machine. **Results:** The majority of the patients were in the age group of 20-40 years.The commonest presenting clinical feature was abdominal pain (83.14%). Rest included altered bowel habits (71.0%), weight loss (10.2%), fever (0.4%) and malena (0.2%). **Conclusion:** Computed tomography enterography (CTE) in patients with small bowel obstruction helps to determine the cause and site of obstruction that correlates well with the postoperative findings.CTE characteristics help in differentiating active Crohn's disease from chronic Crohn's disease. Hence, it should be routinely indicated for better localization of lesions, delineation of extent and mural enhancement pattern for suggesting the disease activity, to assess and track progression of extraintestinal manifestations and complications of disease.

Key words: small bowel, CT enterography, diverticulitis

INTRODUCTION

The pathological processes occurring in the small bowel are seen in a number of patients attending hospital, irrespective of their age and sex.[1] Though, the spectrum of diseases involving small bowel is diverse and includes neoplastic lesions (benign and malignant), inflammatory bowel diseases, radiation enteritis, infectious enteritis, diverticulitis, infiltrative enteritis like scleroderma, visceral angioedema, amyloidosis, obscure gastrointestinal bleeding, small bowel ischemia and hemorrhage, postoperative adhesions.[2] However, small bowel remains the most challenging segment of the gastrointestinal tract to examine and is an enigma for clinicians to assess and evaluate. The presentations include pain abdomen, altered bowel habits, gastrointestinal bleed, loss of appetite, weight loss, fever, anemia and many more.[3]

Traditionally, the imaging of small bowel pathologies has been performed with barium follow-through examinations, single or double contrast intubated enteroclysis and computed tomography (CT). Recent innovations like capsule endoscopy and Magnetic Resonance imaging (MRI) have emerged as alternative small bowel imaging techniques.[4] Imaging evaluation of the small bowel has been improved using CT and technical advances including the use of multidetector CT (MDCT) scanners that acquire isotropic data, oral contrast agents and administration techniques that improves small bowel distention. These advances, coupled with imaging work stations that allow 3 dimensional (3D) evaluation of these isotropic data sets, have allowed improved depiction and characterization of the small bowel pathology.5 CT enterography (CTE) is a technique that uses MDCT, neutral (attenuation values between 10-30 Hounsefield units [HU]) oral contrast agents (to distend the small bowel) and multiplanar thin section data evaluation.[6]The present study was conducted to assess the outcomes of CT enterography in patients with small bowel diseases.

MATERIALS & METHODS

This study was a hospital based observational study which was conducted in the Post Graduate Department of Radiodiagnosis and Imaging, Government Medical College Srinagar, Jammu and Kashmir, India after obtaining ethical clearance from institutional ethics committee. Study group consisted of 214 patients who presented with different small bowel pathologies referred by the Gastroenterology department and other departments of Government Medical College.

Data such as name, age, gender etc. was recorded. An adequate detailed history was elicited from all patients, followed by clinical examination and relevant laboratory investigations of every patient prior to imaging procedure as per the annexed proforma. A brief account of the procedure was explained to the patients. Informed and written consent was taken from all patients prior to the procedure.

All patients were prepared with a 24 hours residue free liquid diet and complete fasting 4 hours before the study. All the CT enterography scans were performed with helical CT scanner – FOURTH GENERATION 256 SLICE CT SOMATOM DEFINITION AS FLASH (Siemens Healthcare, Forchheim, Germany) machine. A single breath-hold scan was obtained from the diaphragm to the symphysis pubis with a section thickness of 2 to 2.5 mm and a reconstruction interval of 1.0 to 1.5 mm. Both non enhanced and contrast enhanced scans were performed in supine position and full inspiration wherever possible.Computed tomography enterographswere reviewed by an experienced radiologist. The focus of image analysis was on evaluating CT parameters in a patterned approach including location in bowel (duodenum, jejunum, ileum), location within wall (mucosa, submucosa, serosa), mural enhancement pattern (target, homogenous, heterogenous, decreased), mural stratification, length of involvement (focal, segmental, diffuse), degree of thickening (mild, moderate, severe), type of thickening (symmetric, asymmetric), mucosal folds, submucosal fat deposition, pseudosacculation, ileocaecal junction involvement, mesenteric vascular prominence (Comb sign), mesenteric fat stranding, mesenteric fibrofatty proliferation, increased perienteric fat attenuation, mural attenuation value, abnormal to normal loop enhancement ratio, omental and mesenteric thickening, presence of stricture, fistula, lymphadenopathy and ascites.Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of patients by age

CT Diagnosis	Age Group					
	0-10 years	10-20 years	20-30 years	30-40 years	40-50 years	>50 years
Active Crohn's disease	1	10	9	5	2	1
Chronic Crohn's disease	0	1	8	3	2	1
Tubercular enteritis	1	3	8	13	8	3
Infectious enteritis	1	2	2	1	0	0
Small bowel neoplasms	0	2	8	19	11	10
Celiac sprue	0	1	2	0	0	0
Intestinal obstruction	1	14	18	12	6	3
Radiation enteritis	0	0	0	1	1	0
Pneumatosis intestinalis	0	0	2	2	1	0
Wilkie's syndrome	0	2	1	0	0	0
Meckels's diverticulitis	0	1	2	0	0	0
Mesenteric ischemia	0	0	1	4	3	0
Small bowel diverticula	0	0	0	1	0	0
Total	4	36	61	61	34	18
Percentage	1.8%	16.8%	28.6%	28.6%	15.8%	8.4%

Age ranged from 8 to 72 years with mean age of 34.02 years. The majority of the patients were in the age group of 20-40 years.

Table II Clinical features of patients

Clinical features	Number of patients	Percentage
Pain abdomen	178	83.14%
Altered bowel habits	152	71.0%
Weight loss	22	10.2%
Fever	9	0.4%
Malena	5	0.2%

The commonest presenting clinical feature was abdominal pain (83.14%). Rest included altered bowel habits (71.0%), weight loss (10.2%), fever (0.4%) and malena (0.2%).

Table III Mural CT characteristics of IBD, TB enteritis, infectious enteritis and celiac sprue

S. No.	CT Characteristics	Active Crohn's disease		Chronic Crohn's disease		Tubercular enteritis		Infectious enteritis		Celiac sprue	
		No.	%	No.	%	No.	%	No.	%	No.	%
1.	Location in bowel-										
	Duodenum	1	3.5	1	6.6	0	0	2	33.3	0	0
	Jejunum	8	28	6	40	4	11.1	3	50	2	66.6
	Ileum	28	100	15	100	36	100	1	16.6	1	33.4
2.	Location within wall-										
	Mucosa	28	100	15	100	36	100	6	100	6	100
	Submucosa	0	0	0	0	0	0	0	0	0	0
	Serosa	0	0	0	0	0	0	0	0	0	0
3.	Mural enhancement-										
	Double halo/ Target appearance	24	85.7	0	0	0	0	6	100	0	0
	Homogenous	4	14.3	11	73.4	31	86.2	0	0	3	100
	Heterogenous	0	0	0	0	5	13.8	0	0	0	0
	Decreased	0	0	4	26.6	0	0	0	0	0	0
4.	Mural stratification-										
	Maintained	28	100	3	20	3	8.3	6	100	2	66.6
	Lost	0	0	12	80	33	91.7	0	0	1	33.4
5.	Length of involvement-										
	Focal (≤ 5 cm)	6	21.4	3	20	15	41.6	0	0	2	66.6
	Segmental (6-40 cm)	22	78.5	12	80	16	44.4	2	33.3	1	33.4
	Diffuse (>40 cm)	0	0	0	0	5	13.8	4	66.6	0	0
6.	Degree of thickening-										
	Mild (3-4 mm)	2	7.2	2	13.3	4	11.1	3	50	1	33.4
	Moderate (5-9 mm)	8	28.5	9	60	18	50	2	33.3	2	66.6
	Marked (≥ 10mm)	18	64.3	4	26.7	14	38.9	1	16.6	0	0
7.	Type of thickening-										
	Symmetric	26	92.8	11	73.3	9	25	6	100	3	100
	Asymmetric	2	7.2	4	26.6	27	75	0	0	0	0
8.	Mucosal folds-										
	Normal	28	100	15	100	36	100	6	100	0	0
	Jejunisation of ileum	0	0	0	0	0	0	0	0	3	100
9.	Submucosal fat deposition-										
	Present	0	0	15	100	3	8.3	0	0	0	0
	Absent	28	100	0	0	33	91.7	6	100	3	100
10.	Pseudosacculation-										
	Present	0	0	11	73.3	0	0	0	0	0	0
	Absent	28	100	4	26.7	36	100	6	100	3	100
11.	Ileocaecal junction involvement-										
	Present	7	25	5	33.3	36	100	0	0	0	0
	Absent	21	75	10	66.7	0	0	6	100	3	100
12.	Mural attenuation value-										
	>109 HU	24	85.7	1	6.7	0	0	0	0	0	0
	≤ 109 HU	4	14.3	14	93.3	36	100	6	100	3	100
13.	Abnormal to normal loop enhancement ratio-										
	>1.3	22	78.6	1	6.7	0	0	0	0	0	0
	≤1.3	6	21.4	14	93.3	36	100	6	100	3	100

Table III compares the differences in mural CT characteristics of active Crohn's disease, chronic Crohn's disease, tubercular enteritis, infectious enteritis and celiac sprue.

Table IV Extramural CT characteristics of ibd, tb enteritis, infectious enteritis and celiac sprue

S. No	CT Characteristics	Active Crohn's disease		Chronic Crohn's disease		Tubercular enteritis		Infectious enteritis		Celiac sprue	
		No.	%	No.	%	No.	%	No.	%	No.	%
1.	Mesentric vascular prominence (Comb sign)										
	Present	26	92.8	3	20	7	19.4	3	50	1	33.3
	Absent	2	7.2	12	80	29	80.6	3	50	2	66.7
2.	Mesentric fat stranding-										
	Present	20	71.4	2	13.3	5	13.9	2	33.3	0	0
	Absent	8	28.6	13	86.7	31	86.1	4	66.7	3	100
3.	Mesentric fibrofatty proliferation-										
	Present	6	21.4	12	80	0	0	0	0	0	0
	Absent	22	78.6	3	20	36	100	6	100	3	100
4.	Increased perienteric fat attenuation-										
	Present	24	85.7	2	13.3	0	0	0	0	0	0
	Absent	4	14.3	13	86.7	36	100	6	100	3	100
5.	Omental and Mesenteric thickening-										
	Present	0	0	2	13.3	32	88.9	0	0	0	0
	Absent	28	100	13	86.7	4	11.1	6	100	3	100
6.	Lymphadenopathy-										
	Low attenuation	0	0	0	0	29	80.6	0	0	2	66.7
	Soft tissue density	5	17.9	3	20	7	19.4	2	33.3	0	0
	Absent	23	82.1	12	80	0	0	4	66.7	1	33.3
7.	Ascites-										
	High density ascites (25-45 HU)	0	0	0	0	23	63.9	0	0	0	0
	Low density ascites (<30 HU)	3	10.7	1	6.7	3	8.4	1	16.7	1	33.3
	Absent	25	89.3	14	93.3	10	27.7	5	83.3	2	66.7

Table IV compares the extramural CT characteristics of active Crohn's disease, chronic Crohn's disease, tubercular enteritis, infectious enteritis and celiac sprue.

DISCUSSION

Small bowel pathologies are a dilemma for clinicians to assess and investigate. The evaluation of small bowel has been traditionally difficult due to the length/caliber of small intestine, overlap of loops and difficulty with access other than by operative means. The differential diagnosis of the abnormal small bowel diseases is extensive with variants and imaging pitfalls. Optimal evaluation of abnormal small bowel loops is facilitated when the small bowel is well distended, IV contrast material has been administered and thin-section CT is used. CT enterography should be used when a clinical concern exists for small bowel disease.[7]

The present study evaluated various small bowel diseases on the basis of the following CT characteristics: location in bowel, location within wall, mural enhancement, mural stratification, length of involvement, degree of thickening, type of thickening, mucosal folds, submucosal fat deposition, pseudosacculation, ileocaecal junction involvement, mesenteric vascular prominence (Comb sign), mesenteric fat stranding, mesenteric fibrofatty proliferation, increased perienteric fat attenuation, mural attenuation value, abnormal to normal loop enhancement ratio, omental and mesenteric thickening, presence of stricture, fistula, lymphadenopathy and ascites. Many of these parameters have not been evaluated in patients with small bowel diseases in the studies done in past.[8,9] Hence, this study is new in itself with respect to a patterned approach to small bowel diseases using CT enterography.

We analyzed a study group of 214 patients to study the varied spectrum of small bowel pathologies on CT enterography. There were 115 male and 99 female patients (F:M=0.86), the average age was 34.02 years (range 8-72 years). The maximum number of cases occurred in the age group of 20-40 years. The most common clinical feature was pain abdomen (83.14%) followed by altered bowel habits (71.0%). These observations are comparable to a study by Misra RN et al[10] where there were 14 male and 16 female patients in the study, age ranged from 16-70 years (mean age-31.03years).

The spectrum of small bowel pathologies detected on CT enterography in our study included 214 cases which comprised of small bowel obstruction (n/%-54/25.2%), small bowel neoplasms (50/23.3%), Crohn's disease (43/20.08%), tubercular enteritis (36/16.7%), mesenteric ischaemia (8/3.7%), infectious enteritis (6/2.8%), pneumatosis intestinalis (5/2.3%), wilkie's syndrome (3/1.4%), meckel's diverticulitis (3/1.4%), celiac sprue (3/1.4%), , radiation enteritis (2/0.9%), and small bowel diverticula (1/0.4%). In a study done byJimenez DU et al[11], 90 patients were evaluated on CTE and diagnosis spectrum included crohn's disease (4), small bowel neoplasms (4), small bowel obstruction (5), lower GI bleed (1), other findings (51) and rest were normal. Our findings show a higher incidence of Crohn's disease likely due to the demographic variation of the disease.

There were 22(51.1%) males (age range 20-50 years) and 21(48.8%) females (age range 20-40 years) amongst the cases of Crohn's disease in our study. A total of twenty-eight cases (65.1%) were diagnosed as active Crohn's disease and fifteen cases (34.9%) were diagnosed as chronic Crohn's disease on CTE. This was comparable with the study by Hassan A et al[12] where 18 (55%) cases were men (age range 20-60 years) and 15 (45%) cases were women (age range 21-63 years) and amongst these, twenty-two patients (67%) had active disease, two (6%) had inactive disease.

CONCLUSION

Computed tomography enterography (CTE) in patients with small bowel obstruction helps to determine the cause and site of obstruction that correlates well with the postoperative findings.CTE characteristics help in differentiating active Crohn's disease from chronic Crohn's disease. Hence, it should be routinely indicated for better localization of lesions, delineation of extent and mural enhancement pattern for suggesting the disease activity, to assess and track progression of extraintestinal manifestations and complications of disease.

REFERENCES

1. Macari M and Balthazar EJ. CT of bowel wall thickening, significance and pitfalls of interpretation. AJR 2001; 176: 1105-16.
2. Jeboes K, Jeboes KP, Maleux G. Vascular anatomy of the gastrointestinal tract: Best Pract Res Clin Gastroenterol. 2001 Feb; 15(1): 1-14.
3. Macari M, Megibow AJ and Balthazar EJ. A pattern approach to the abnormal small bowel observations at MDCT and CT enterography. AJR 2007; 188: 1344-55.
4. Kohli MD, Maglinte DDT. CT enteroclysis in incomplete small bowel obstruction. Abdominal Imaging 2009; 34(3): 321-27.
5. Lee SS, Kim AY, Yang SK et al. Diseases of the small bowel: Comparison of CT Enterography, MR Enterography and small bowel follow through as Diagnostic techniques. Radiology 2009; 251: 751-61.
6. Siddiki HA, Fidler JL, Fletcher JG et al. Prospective comparison of state of the art MR enterography and CT enterography in small bowel Crohn's disease. AJR 2009; 193: 113-21.
7. Hakim FA, Alexander JA, Grover M et al. CT Enterography may identify small bowel tumors not detected by capsule endoscopy: eight years experience at Mayo clinic Rochester. Dig Dis Sci. 2011 Oct; 56(10): 2914-9.
8. Sodhi JS, Ahmed A, Shoukat A et al. Diagnostic role of capsule endoscopy in patients of obscure gastrointestinal bleeding after negative CT enterography. Journal of Digestive Endoscopy. 2013; 4: 107-13.
9. Sheth R, Gee M. The Role of Imaging in Inflammatory Bowel Disease Evaluation. Inflammatory bowel disease–advances in pathogenesis and management 2012 page 137-150.
10. Misra RN, Bajaj SK. Role of CT enterography in evaluation. Int J Res Med Sci. 2019 Feb; 7(2): 537-43.
11. Jimenez DU, Oscar DMB, Orlando W, Cotrino S et al. Use of CT enterography for small bowel pathology: Experience and findings in 90 patients: Revista Columbiana de Radiologia. 2010; 21(1): 2818-25.
12. Hassan A, Fidler JL, Fletcher JG et al. Prospective comparison of state-of-the-art MR Enterography and CT Enterography in small-bowel Crohn's disease. AJR 2009; 193: 113-21.