ORIGINAL RESEARCH

Qualitative and quantitative assessment of disease activity in patients with Crohn's disease: A patterned approach on multidetector computed tomography enterography

[1]Ankit Prabhakar, [2]Shivani Sharma, [3]Shaafiya Ashraf

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

ABSTRACT
Background: Small bowel pathologies is an enigma for clinicians to assess and investigate. The present study was conducted to explore the feasibility of computed tomography enterography (CTE) in the qualitative and quantitative evaluation of the activity of Crohn's disease (CD) using a patterned approach. **Materials & Methods:** 43 patients with Crohn's disease (CD) of both genderswere subjected to CTE. Helical CT scanner – fourth generation 256 slice CT somatom. **Results:** Active Crohn's disease was seen maximally in age group 20-30 years (10) and chronic form in age group 20-30 years (8). Clinical features were pain abdomen in 38, altered bowel habits in 35 and weight loss in 8 patients. The location was ileum in 100% in active form, mural enhancement was double halo/ target appearance in 85.7% in active form and 73.4% in chronic form. Mural stratification was maintained in 100%. Length of involvement was focal (< 5 cm) in 6 (21.4%) and 3 (20%) and segmental (6-40 cm) in 22 (78.5%) and 12 (80%) in active and chronic form respectively. Mesentric vascular prominence (Comb sign) was seen in 92.8% and 20%, Mesentric fat stranding was present in 71.4% and 13.3%, Mesentric fibrofatty proliferation was present in 21.4% and 80% in active and chronic crohn's disease respectively.
Conclusion: A careful analysis of several CT parameters in a patterned approach helps to indicate diagnosis and assess disease activity of Crohn's disease, differentiating active Crohn's disease from chronic Crohn's disease.
Key words: Small bowel, computed tomography enterography, crohn's disease

INTRODUCTION
Small bowel pathologies is an enigma for clinicians to assess and investigate. It has difficult evaluation due to the length/caliber of the small intestine, overlap of loops, and difficulty with access other than by operative means.Crohn's disease important chunk of this disease spectrum, a chronic granulomatous inflammatory disease with remission and relapse, can affect any part of the GIT, multiple discontinuous sites, and terminal ileum (80% cases).[1,2,3]
CTE is widely used in clinical practice, and can reveal intestinal lesions, assess intestinal inflammation, and extraintestinal complications.[4,5] So far, very few studies have made a quantitative assessment of lesion activity based on CTE imaging findings. This might help to have an impact on medical decision-making, prognosis assessment, and treatment efficacy depending on the disease severity stratification by CTE.[6,7,8]The present study was conducted to explore the feasibility of computed tomographyenterography (CTE) in the qualitative and quantitative evaluation of the activity of Crohn's disease (CD) using a patterned approach.

MATERIALS & METHODS
The present study consisted of 43 patients with Crohn's disease (CD) of both genders. All gave their written consent to participate in the study.

Inclusion criteria was patients who needed to be evaluated for suspected or previously diagnosed Crohn's disease. Exclusion criteria was pregnant, renal insufficiency (serum creatinine level of 2.0 mg/dl or greater) and prior history of allergic reaction to iodinated contrast material.

Data such as name, age, gender etc. was recorded. All were subjected to CTE. Helical CT scanner – fourth generation 256 slice CT somatom definition as flash (Siemens Healthcare, Forchheim, Germany) machine. Mural hyperenhancement - segmental hyperenhancement of distended small bowel loops relative to nearby normal-appearing loops.Mural stratification - trilaminar appearance, an internal ring of mucosal enhancement; an external ring of serosal and muscular enhancement; an interposed submucosal layer with decreased attenuation.Length of involvement - Focal (< 5 cm), Segmental (6-40 cm), Diffuse (>40 cm), degree of thickening - mild (3-4 mm), moderate (5-9 mm), marked (> 10mm), MAV > 109 HU, abnormal to normal loop enhancement ratio > 1.3. Stricture(Inflam/Fibrotic)-Luminal narrowing >50% with upstream bowel dilation > 3cm. Extraenteric complications: Fistulas, Abscesses, mesenteric lymphadenopathy, cholelithiasis, nephrolithiasis, venous thrombosis, sacroiliitis and primary sclerosing cholangitis.Data thus obtained were subjected to statistical analysis. P value < 0.05 was considered significant.

RESULTS

Table I Distribution of patients

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

Table I shows that active Crohn's disease was seen maximally in the age group 20-30 years (10) and chronic form in the age group 20-30 years (8).

Graph I Assessment of clinical features
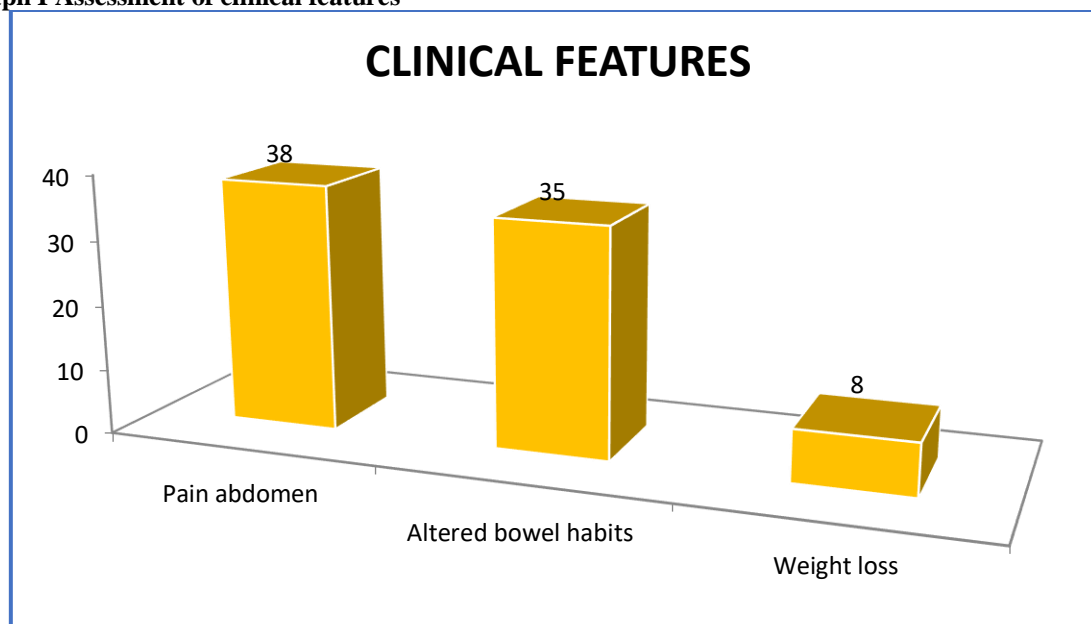
Graph I shows that clinical features were pain abdomen in 38, altered bowel habits in 35 and weight loss in 8 patients.

Table II Mural CT characteristics of crohn's disease

S. No.	CT Characteristics	Active Crohn's disease		Chronic Crohn's disease		
		No.	%	No.	%	
1.	**Location in bowel-**					
	Duodenum	1	3.5	1	6.6	
	Jejunum	8	28	6	40	
	Ileum	28	100	15	100	
2.	**Location within wall-**					
	Mucosa	28	100	15	100	

	Submucosa	0	0	0	0	
	Serosa	0	0	0	0	
3.	**Mural enhancement-**					
	Double halo/ Target appearance	24	85.7	0	0	
	Homogenous	4	14.3	11	73.4	
	Heterogenous	0	0	0	0	
	Decreased	0	0	4	26.6	
4.	**Mural stratification-**					
	Maintained	28	100	3	20	
	Lost	0	0	12	80	
5.	**Length of involvement-**					
	Focal (< 5 cm)	6	21.4	3	20	
	Segmental (6-40 cm)	22	78.5	12	80	
	Diffuse (>40 cm)	0	0	0	0	
6.	**Degree of thickening-**					
	Mild (3-4 mm)	2	7.2	2	13.3	
	Moderate (5-9 mm)	8	28.5	9	60	
	Marked (> 10mm)	18	64.3	4	26.7	

Table II shows that location was ileum in 100% in active form, mural enhancement was double halo/ target appearance in 85.7% in active form and 73.4% in chronic form. Mural stratification was maintained in 100%. Length of involvement was focal (< 5 cm) in 6 (21.4%) and 3 (20%) and segmental (6-40 cm) in 22 (78.5%) and 12 (80%) in active and chronic form respectively.

Table III Extramural CT characteristics of crohn's disease

S. No	CT Characteristics	Active Crohn's disease		Chronic Crohn's disease	
		No.	%	No.	%
1.	**Mesentric vascular prominence (Comb sign)-**				
	Present	26	92.8	3	20
	Absent	2	7.2	12	80
2.	**Mesentric fat stranding-**				
	Present	20	71.4	2	13.3
	Absent	8	28.6	13	86.7
3.	**Mesentric fibrofatty proliferation-**				
	Present	6	21.4	12	80
	Absent	22	78.6	3	20

Table III shows that mesentric vascular prominence (Comb sign) was seen in 92.8% and 20%, Mesentric fat stranding was present in 71.4% and 13.3%, Mesentric fibrofatty proliferation was present in 21.4% and 80% in active and chronic crohn's disease respectively.

Table IV Histopathological correlation and follow up of cases of crohn's disease

S. No	Characteristics	Active Crohn's disease		Chronic Crohn's disease	
		No.	%	No.	%
1.	**HPE correlation-**				
	Correlated	27	96.4	15	100
	Not correlated	1	3.6	0	0
2.	**Follow up on treatment-**				
	Improved	22	78.6	11	73.3
	Not improved	6	21.4	4	26.7

Table IV shows that HPE correlation was seen in 96.4% and 100% in active and chronic form respectively. On follow up, 78.6% active and 73.3% chronic form showed improvement.

DISCUSSION

Crohn's disease of the small bowel, also known as ileal Crohn's disease, is a type of inflammatory bowel disease (IBD) that primarily affects the small intestine, specifically the ileum.[9,10,11] Crohn's disease is a chronic inflammatory condition that can affect any part of the digestive tract, from the mouth to the anus, but it most commonly occurs in the ileum and

1719

colon.[12,13]The present study was conducted to explore the feasibility of computed tomographyenterography (CTE) in the qualitative and quantitative evaluation of the activity of Crohn's disease (CD) using a patterned approach.

We found that active Crohn's disease was seen maximally in age group 20-30 years (10) and chronic form in age group 20-30 years (8). We observed that clinical features were pain abdomen in 38, altered bowel habits in 35 and weight loss in 8 patients. The location was ileum in 100% in active form, mural enhancement was double halo/ target appearance in 85.7% in active form and 73.4% in chronic form. Mural stratification was maintained in 100%. Length of involvement was focal (< 5 cm) in 6 (21.4%) and 3 (20%) and segmental (6-40 cm) in 22 (78.5%) and 12 (80%) in active and chronic form respectively. We observed that mesentric vascular prominence (Comb sign) was seen in 92.8% and 20%, Mesentric fat stranding was present in 71.4% and 13.3%, Mesentric fibrofatty proliferation was present in 21.4% and 80% in active and chronic crohn's disease respectively. HPE correlation was seen in 96.4% and 100% in active and chronic form respectively. On follow up, 78.6% active and 73.3% chronic form showed improvement. One study from the Mayo Clinic has shown that CTE detects active Crohn's disease with a sensitivity as well as ileocolonoscopy, using absolute bowel wall enhancement (ROC analysis: $Az = 0.81$).[14]

Active Crohn's disease exhibited mural hyperenhancement, double halo pattern (85.7% sensitivity), maintained mural stratification (93.02% diagnostic accuracy), segmental involvement, mesenteric fat stranding (71.4% sensitivity), comb sign (92.8% sensitivity), increased perienteric fat attenuation (85.7% sensitivity), mural attenuation value > 109 HU (88.3% diagnostic accuracy) and abnormal to normal loop enhancement ratio of > 1.3 (83.7% diagnostic accuracy).

Chronic Crohn's disease exhibited homogenous mural enhancement, lost stratification, segmental involvement, submucosal fat deposition, pseudosacculation (73.3% sensitivity), mesenteric fibrofatty proliferation (80% sensitivity), mural attenuation value < 109 HU and abnormal to normal loop enhancement ratio < 1.3. Mural attenuation value > 109 HU and abnormal to normal loop enhancement ratio of > 1.3 can be used as a reliable quantitative tool for measuring mural enhancement rather than to rely on subjective visual assessment by a radiologist, with a sensitivity of 85.7% & 78.5% and specificity of 93.3% each respectively, in active Crohn's disease.

CONCLUSION

Authors found that a careful analysis of several CT parameters in a patterned approach helps to indicate diagnosis and assess disease activity of Crohn's disease, differentiating active Crohn's disease from chronic Crohn's 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. Paulsen SR, Huprich JE, Fletcher JG et al. CT enterography as a diagnostic tool in evaluating small bowel disorders: Review of clinical experience with over 700 cases. Radiographics 2006; 641-657.
5. Buckley JA, Fishman EK. CT evaluation of small bowel neoplasms: spectrum of disease. Radio-Graphics1998; 18: 379-92.
6. Rubesin SE, Herlinger H, Saul SH et al. Adult celiac disease and its complications. RadioGraphics1989; 9: 1045-66.
7. Laghi A, Paolantonio P, Catalano C, et al. MR imaging of the small bowel using polyethylene glycol solution as an oral contrast agent in adults and children with celiac disease: preliminary observations. AJR2003; 180: 191-94.
8. Gore RM, Balthazar EJ, Ghahremani GG et al. CT features of ulcerative colitis and Crohn's disease. AJR1996; 167: 3-15.
9. Wiesner W, Khurana B, Ji H, Ros PR. CT of acute bowel ischemia. Radiology2003; 226: 635-50.
10. Balthazar EJ, Noordhoorn M, Megibow AJ et al. CT of small-bowel lymphoma in immunocompetent patients and patients with AIDS: comparison of findings. AJR1997; 168: 675-80.
11. De Backer AI, De Schepper AM, Vandevenne JE et al. CT of angioedema of the small bowel. AJR2001; 176: 649-52.
12. Hyun KH, Lee SH, Rha SE, et al. Radiologic features of vasculitis involving the gastrointestinal tract. RadioGraphics2000; 20: 779-94.
13. Kalantari BN, Mortele KJ, Cantisani V, et al. CT features with pathologic correlation of acute gastrointestinal graft-versus-host disease after bone marrow transplantation in adults. AJR2003; 181: 16210-25.
14. Bodily K D, Fletcher J G, Solem C A, et al. Crohn disease: mural attenuation and thickness at contrast-enhanced ct enterography – correlation with endoscopic and histologic findings of inflammation. Radiology. 2006;238:505–516.