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Role of Multidetector Computed Tomography Enterography in the Evaluation of Small Bowel Disorders

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A B S T R A C T

Introduction: The mesenteric small intestine diagnostic study is not principally dependent on endoscopic viewing. Increased speed and resolution of MDCThave made it a first line modality for the examination of small bowel diseases. MDCT Enterography differs from routine abdomino-pelvic CT as it makes use of thin sections and large volumes of enteric contrast material for better display of the small bowel lumen and wall, permits excellent assessment of hyper vascular lesions and hyper enhancing segments. ***Objectives*:** 1) To study the radiological features of small intestinal diseases. 2) To draw a systematic patterned approach to narrow down the differential diagnosis based on radiological findings. 3) To evaluate the diagnostic accuracy of MDCT Enterography with clinical, histopathological and surgical correlation. ***Materials and Methods***: Total 40 cases of suspected small intestinal disease referred to underwent MDCT Enterography at Department of Radio-Diagnosis of SSIMS & RC, Davangere from the year June 2023 to December 2024.Imaging was done on a 128slice MDCT scanner manufactured by GE MDCT scan machine.***Results:***The common MDCT Enterography findings were distal bowel involvement, mucosal layer involvement, and homogeneous wall enhancement. Focal involvement was seen in majority of patients with mild mural thickness. Small bowel obstruction was commonest cause, followed by abdominal tuberculosis. ***Conclusion:***MDCT Enterography is an efficient in detecting small bowel pathologies. Distal bowel and mucosal layer involvement, homogeneous wall enhancement, focal involvement with the mild mural thickening are most common findings. Small bowel obstruction and abdominal tuberculosis being the most common diseases.

Keywords: MDCT Enterography, small bowel diseases, enteric contrast, mannitol.

INTRODUCTION

Small intestinal pathologies are relatively rare. They account for only 1%-4% of digestivediseases [1]. Though there is recent development of techniques like endoscopy, capsuleendoscopy and double-balloon push enteroscopy, the diagnosis of small intestinal diseases isstill difficult [2].

The small intestine is that portion of gastrointestinal tract (GIT) for which diagnostic study is not primarily dependent on endoscopic viewing. Therefore, in such a situation, the need for radiological diagnosis of small bowel pathologies becomes important. After the inventor of CT, owing to its increased speed and resolution, Multi–detector row computed tomography (CT) has become the first-line imaging modality for examination of small bowel pathologies [3].

Multi-Detector Computed Tomography (MDCT) is a widely accepted investigation of choicein a lot of conditions. It is rapid, specific, time efficient, objective and informative. Withadvanced technology of MDCT, it allows multiple images to be acquired in a single tuberotation [4]. Within a single breath held at a thickness of sub-millimetre (0.5 to 0.75mm) in the 3D plane, the entire abdomen and pelvis can be scanned. These data sets result in voxels thatare both sub millimetre in dimension and isotropic, suggesting that reformations in anydesired plane will have a spatial

resolution similar to that of the axial plane. It providesinformation of the gastrointestinal tract, mesenteries, solid organs, peritoneum and retroperitoneal areas [5].

So, how is it different from a routine CT of abdomen and pelvis? That is, it provides us with thinner sections but there is a need for large volumes of enteric contrast material that is to obtain a better illustration of the small bowel lumen as well as the wall. MDCT also allows an excellent evaluation of hypervascular lesions and also hyperenhancing segments [6].

MATERIALS AND METHODS

In this study, the cases with suspected small bowel disease that will be referred to the Department of Radio-Diagnosis of SSIMS & RC, Davangere and inputs from SIMSRC, Bengaluru for the purpose of undergoing MDCT Enterography will be included. The details of the patients like name, age, sex, detailed clinical history will be taken with follow-up/ surgical/ histopathological correlation done later.

Study Design: Prospective observational study.

Study Area: SSIMS & RC; DAVANGERE

Study Duration: June 2022 to December 2023

Sample Size: 40

TECHNIQUE:

Patients undergoing MDCT Enterography were asked to withhold oral intake for duration of about 4 hours prior to examination. 0.2% mannitol suspension (100ml) was administered as a neutral oral contrast agent mixed in 1.35L of water.

A total of 1.35 Level of mannitol was administered over 1 hour (450 ml at 30 minutes, 450 ml at 20 minutes, 225ml at 10 minutes, 225ml before scanning). On ingestion of oral contrast, intravenous contrast (60-80 ml) was injected, then 50 ml of saline solution was administered using a power injector at a rate of 3.5ml/sec. Helical scanning was then performed using a 128 slice MDCT scanner, starting from the diaphragm to the symphysis pubis.

This was a triple phase study that included, late arterial, venous and delayed phase. Late arterial phase is 35-40 sec per injection or 15-20 sec after bolus tracking. Venous phase is 70-80 sec per injection or 50-60 sec after bolus tracking. Delayed phase is 6-10 min per injection or 6-10 min after bolus tracking. Post-processing techniques that were included were axial image reconstruction with a section thickness of 1 mm, reformatting of axial image data for maximum intensity projections and volume rendering when required. Small bowel abnormalities were then assessed, according to these criteria proposed by Macari*et al*., The presence of any small bowel disease will then be interpreted by MDCT Enterography.

STATISTICAL METHOD:

Statistical analysis will be performed using the statistical package of social sciences (SPSS) Version 40. Descriptive statistics will be applied wherever needed. Diagnostic accuracy will be ascertained using sensitivity, specificity, positive predictive value and negative predictive value. p value <0.05 will be considered as statistically significant.

RESULTS

Mean age of the study participants was 44.90±16.81 years. Out of which the majority of them were >50 years old accounting for 42.5%, followed by 22.5% of the patients aged <30 years. Prevalence of patients aged >50 years was statistically significant. 57.5%oftherecruitedpatients were male and the rest 42.5% were females.

Majority of the patients, accounting for about 75% (30/40), were observed to havehomogeneous enhancement patterns. Of which 14 (82.4%) were females and the rest16 (69.6%) were males. Target appearance and diminished enhancement was observedamong 10% (4) patients each. Among these, 3 were males and one was a femalepatient. 5% (2) patients, one being male and one female, were observed showing heterogeneous enhancement pattern on CT enterography.

75 % of the Patients, presented with mild mural thickness, of which 13 female and 17male patients were seen. 15% of the study participants, presented with severe muralthickness observed in 3 female and 3 male patients. 4 patients with moderate mural thickness, 1 was female and 3 were male patients.

Of all the diagnosis, 60% of the patients required a surgical line of management and the remaining 40% were managed conservatively.

7 (20%) of them were found to have ileocecal TB, followed by the Crohn's disease of ileocecal region. Other histopathological findings were GIST (spindle type), gangrenous ileitis, strictures with adhesions, non-specific inflammation, well-differentiated Adenocarcinoma and Neuroendocrine tumors in one patient each.

Table 1: Length of the Small Bowel Involved by Gender

Length of Small Bowel Involved	Female (n, %)	Male (n, %)	Total (n, %)
Diffuse	6 (15%)	0 (0%)	6 (15%)
Focal	10 (58.8%)	11 (47.8%)	21 (52.5%)
Segmental	4 (23.5%)	12 (52.2%)	16 (40%)
Total	**20 (100%)**	**23 (100%)**	**43 (100%)**

Note: The percentages for females and males are calculated within each gender group.

Table 2: Mural Thickness Grading by Gender

Mural Thickness	Female (n, %)	Male (n, %)	Total (n, %)
Mild	13 (76.5%)	17 (73.9%)	30 (75%)
Moderate	1 (5.9%)	3 (13.0%)	4 (10%)
Severe	3 (17.6%)	3 (13.0%)	6 (15%)
Total	**17 (100%)**	**23 (100%)**	**40 (100%)**

Note: There seems to be a discrepancy in the total number of female patients between Table 1 and Table 2. Table 1 lists 20 females, while Table 2 lists 17. Please verify the data for consistency.

Table 3: Probable Diagnosis on CT

Diagnosis on CT	Patients (n)	Percentage (%)
Small Bowel Obstruction	14	35.0
Abdominal Tuberculosis	10	25.0
Mesenteric Ischemia	7	17.5
Carcinoid Tumor	2	5.0
Crohn's Disease	2	5.0
Crohn's Disease/Abdominal Tuberculosis	1	2.5
Duodenal Polyp	1	2.5
GIST in Ileum	1	2.5
Ileocecal Growth - Likely Malignant	1	2.5
Sealed-Off Jejunal Perforation	1	2.5
Total	**40**	**100%**

Table 4: Histopathology Correlation

Histopathology	Patients (n)	Percentage (%)
Ileocecal Tuberculosis	8	20.0
Crohn's Disease of Ileocecal Region	3	7.5
Carcinoid Tumor	1	2.5
Gangrenous Ileitis	1	2.5
GIST - High Grade, Spindle-Type	1	2.5
Ileal Stricture with Ischemic Changes	1	2.5
Ileocecal Adhesion	1	2.5
Non-specific Inflammation of Small Intestine	1	2.5
Well-Differentiated Adenocarcinoma - Distal Ileum	1	2.5
Well-Differentiated Neuroendocrine Tumor	1	2.5
Total	**19**	**47.5%**

DISCUSSION

Role of CT in the field of radiology has a history since 1970. After the introduction of it, has led to wide application in the field of radio-diagnosis and also making it easier for the identification of size and site of tumors more accurately while operating. But the role of it was restricted to solid abdominal organs before. As the research went on, the CT enterography and enteroclysis had become popular diagnostic tools in analyzing the small bowel pathologies. MDCT enterography provides more precise diagnosis and hence the early detection and further management of bowel

pathology can take place. There are no much evidence regarding this purpose. Hence we took a study to analyze the role of MDCT Enterography in evaluating small bowel diseases.

Mean age of the study participants was 44.90±16.81 years. Out of which the majority of them were >50year old, accounting for 42.5% followed by 22.5% of the patients aged <30 years. 20% and 15% of the recruited samples were aged between 30 to 40 and 41 to50 years respectively. Sheikh M T *et al*., also observed only five patients <25years old. In our study, 57.5% of the recruited patients were males and the rest 42.5% were females. Similar to our study, Sheikh MT *et al.*, [7] also observed 45% females and the rest 55% males in their study.

On analyzing the site of intestine involved, majority of the patients accounting for about 55% (22/40) had presented with distal bowel involvement and 41% (17/40) had proximal bowel involvement. Whereas one female patient had presented with both proximal as well as distal bowel involvement. Out of 22 patients with distal bowel involvement, 10(58.8%) were females and 12 (52.2%) males. Of those 17 patients with proximal bowel involved, 6 (35.3%) and 11 (47.8%) were female and male patients respectively. Contrary to our findings, abdominal TB was the commonest finding in Sheikh ET *et al*., [7].

In our study, 45% (18) patients were observed with the involvement of the mucosal layer, out of which nine were male and nine female patients. 16(40%) had shown involvement of all the layers, of which six were females and the other ten male patients. Involvement of Muscularispropria, serosa and submucosa was observed among the 1(2.5%), 2(5%) and 3(7.5%) of the patients respectively.

We observed that the majority of the patients, accounting for about 75% (30/40), were observed to be having homogeneous enhancement pattern. Target appearance and diminished enhancement was observed among 10% (4) patients each. Two patients were observed with the heterogeneous enhancement pattern on CT Enterography. Homogenous wall thickening was the commonest bowel finding in Sheikh M T *et al*., [7] also.

In the present study, majority of the patients accounting for about 52.5% (21/40) had focal lesions followed by the 16(40%) with segmental bowel involvement. Then six females were found to have diffuse small intestinal involvement. Similar to our study, Megally*et al*., [8] found that patients with neoplastic lesions had presented with segmental, asymmetric, marked wall thickening with homogenous wall enhancement, involving the mucosa and submucosa of the ileum associated with enlarged mesenteric lymph nodes. Segmental wall thickening was found in 82.3%, asymmetric wall thickening in 100% of the neoplastic lesions. Marked wall thickening was found in 76.5% out and homogenous wall enhancement 53%. Submucosal involvement was 100% of their study population. Ileum was involved in 41.2% and associated enlarged mesenteric lymph nodes among 64.7%. Segmental wall thickening was found in 10 patients (45.5%), symmetric wall thickening was found in 18 patients (81.8%), mild and moderate wall thickening was found in 18 patients (81.8%), homogenous wall enhancement was found in 12 patients (54.5%).

In our study 75% of the patients were presented with mural thickness, of which 13 female and 17 male patients were seen.15% of the study participants, out of which 3 were females and 3 males were found to have severe mural thickness. 4 patients had moderate mural thickness, in which 1 was female and 3 were male patients.

All the diagnosis, we observed 60% of the patients required a surgical line of management and the remaining 40% were managed conservatively. Majority of the patients had undergone exploratory laparotomy.

The majority of the patients in our study, presented with small bowel obstruction accounting for about 35%, followed by abdominal tuberculosis in 25% of the patients. Then mesenteric ischemia was found among 17.5%. Two patients were found to have Carcinoid tumor and the other probable diagnosis were GIST in ileum, Ileo-caecal growth which was most likely malignant, Crohn's disease, Crohn's disease/ abdominal tuberculosis and sealed off jejunal perforation. Similar to our study, Sheikh MT *et al*., [7] also observed that the prevalence of inflammatory bowel diseases was high which consisted of 28 cases out of which seven patients were diagnosed with intestinal Koch's disease. 4/12 patients had idiopathic inflammatory bowel diseases. Rests of the 17 patients were reported to have findings of non-specific colitis and they responded well with antibiotic treatment. Also in their study, 12 patients were diagnosed to have appendicitis. Axial, Multiplanar Reconstruction (MPR) and curved MPR images were used in their study.

Whereas the study by Kaleya RN *et al.*, [9] has reported that mesenteric venous thrombosis prevalence being < 15%, but potentially lethal. Also in the study by Hara *et al*., [10] reported 71% presenting with Crohn's disease. Similar to our observations, Megally*et al*., [8] also found the prevalence of involvement of submucosa of the small bowel in 86.4% to 90.9% of patients, having both ileal and jejunal involvement. Associated enlarged mesenteric lymph nodes were found in 31.8% of the patients and mesenteric vessel changes in about 40.9% of the patients.

Conservative management was done in 16 (40%) of the patients in our study and rest were manages surgically. Of the 24(60%) patients who underwent surgical management, 23 were managed with laparotomy and one patient with laparoscopy. 12.5% (5/40) of the patients were found to be having adhesions and underwent adhesiolysis. Rest, who were diagnosed with tumors, underwent resection and the specimen was further sent for histopathology.

In our study, findings on histopathology showed 7 (20%) of them having ileocecal TB, followed by Crohn's disease of the ileocaecal region. Other histopathological findings were- GIST (spindle type), stricture and adhesions, gangrenous ileitis, stricture with adhesions, non- specific inflammation, well differentiated adenocarcinoma and neuroendocrine tumours in one patient each.

CONCLUSION

Based on our study, the prevalence of small bowel diseases was higher among the patients aged more than 50 years with male predominance. Majority of the patients had distal bowel involvement. The prevalence of lesions involving mucosal layer was commonly observed followed by all the layers (Submucosal, Muscularispropria and serosa). Homogeneous wall enhancement with focal involvement and mild mural thickness were the common findings on CT Enterography. Small bowel obstruction followed by abdominal tuberculosis was the most common diagnosis on CTE, found in 35% and 25% of the patients respectively. Majority of them, about 60% of the patients required surgical management among which laparotomy was the commonest procedure involved. In about 19 out of 40 patients, diagnosis was further confirmed by histopathological evaluation.

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