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A Study of Small Bowel Lesions Using Computed Tomography Enterography

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Abstract
Inflammatory bowel disease once considered to be a western disease is increasingly reported from India and other Asian countries. In India, CD was considered as nonexistent until 1986 and is frequently misdiagnosed as enteric tuberculosis, or even amoebic colitis. To study the mucosal patterns, bowel wall thickness, bowel wall enhancement, luminal distension, luminal disposition and blood vessels in various diseases of the small bowel. This prospective correlation study was conducted among all patients who will be referred to the department of Radio-diagnosis and Imaging, Osmania general hospital for CT enterography For evaluation of small bowel lesions. In our study, the predominant age group involved in this study was 21-30 yrs. The predominant gender involved in this study was males constituting 27 out of 50 patients (54%). Most of the patients presented with pain abdomen (44.4%). majority of the patients were diagnosed as tuberculosis. the most common segment of small bowel involved was terminal ileum. Adequacy of bowel distension was better with CTE, constituting 29 out of 50 cases showing grade 3 distension, 18 cases showing grade 2 and 3 showing grade 1. Bowel distension grading was found to be better with CT enterography where 29 out of 50 patients achieved grade 3 distension. Duodenal adenocarcinoma and duodenal lymphoma had heterogenous enhancement. In our present study, sensitivity and specificity of CTE in diagnosing small bowel tuberculosis is 90% and 90% respectively. In our present study, sensitivity and specificity of CTE in diagnosing crohns disease is 75% and 91.1% respectively. In our present study, sensitivity and specificity of CTE in diagnosing duodenal adenocarcinoma, duodenal lymphoma is 66.6% and 95.7% respectively. CT enterography can be used as a method of choice for evaluation of diffuse small bowel pathologies. CT enterography with adequate bowel luminal distension and negative oral and intravenous contrast can be used to detect mucosal enhancement, mural stratification, luminal and extra luminal complications of small bowel pathologies. CT enterography is an excellent technique for evaluation of crohns disease with excellent visualization of mucosal enhancement, mural stratification, extra luminal findings like fibro fatty proliferation, combs sign and other complications such as strictures and fistulas.

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Key Words
Small bowel lesions, computed tomography enterography, mucosal enhancement

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INTRODUCTION

Inflammatory bowel disease has traditionally been thought to be uncommon in India. Overall incidence and prevalence of CD in the Asia-Pacific region is reported to be lower than the estimated incidence and prevalence in North America or Europe.

However in the past few years, there has been a growing realization that, despite the high prevalence of intestinal tuberculosis, CD does occur in India. This has been attributed to increasing awareness and availability of diagnostic facilities, coupled with improved sanitation as is being seen in the rest of Asia[1].

Extra pulmonary form of TB accounts for 10-15% of all cases and TB of GIT is sixth most common site of extra pulmonary TB. Small bowel accounts for only 2% of GIT cancers and in India incidence of adenocarcinoma of small bowel is 100,000 per year.

The small bowel is affected by a host of pathological conditions. Imaging of Small bowel is complicated, difficult and challenging because of its length, tortuous course, motility and superimposition. For many years, the most common radiologic modality for evaluating small bowel diseases are barium small bowel follow through.

Therefore there came the evolution of cross sectional imaging with CT in small bowel at most institutions due to its widespread availability, low cost and higher spatial and temporal resolution[2].

With the development of multi slice CT, imaging larger volume at faster speed and multi planar reconstruction after the procedure makes CT a more convenient procedure for examining small bowel diseases. But the main disadvantage of CT is it is based on ionizing radiation Computed topographic enterography (CTE) is an emerging modality for the assessment of disorders of the small bowel[3].

It combines the greatly improved spatial and temporal resolution provided by multi detector CT scanners, combined with the use of neutral or low-density oral contrast agents and non-ionic intravenous contrast agents for the optimal depiction of small bowel diseases.

Excellent visualization of the entire bowel wall thickness, visualization of the mucosa, depiction of extra-enteric involvement, detailed and comprehensive information about the extent and severity of the disease process have made CT enterography the primary imaging modality in evaluating bowel diseases.

CT enterography is not only used for investigating proved or suspected inflammatory bowel disease like tuberculosis, crohns, typhoid enteritis etc but also for detecting occult gastrointestinal tract bleeding, small bowel neoplasms, mesenteric ischemia, mal rotations, post-operative adhesions etc.

The purpose of this study is to describe the application of CTE technique in the evaluation of various small intestinal diseases.

MATERIALS AND METHODS

This prospective correlation study was conducted among all patients who will be referred to the department of Radio-diagnosis and Imaging, Osmania general hospital for CT enterography For evaluation of small bowel lesions. Duration of Study 24 months (October 2017-October 2019).

Sample Size: 50.

Inclusion Criteria:

- Patients with clinically suspected small intestinal diseases.
- Age groups 18-60 years are included.
- Both sexes are included.

Exclusion Criteria:

- Any person with abnormal RFT.
- Known severe allergy to IV contrast.
- Upper GI obstruction and pregnancy.

CT Enterography Procedure: Informed written consent is taken Patients undergoing CT enterography are asked to withhold all oral intake, overnight before the examination and asked to take one tablet of dulcolax(laxative) night before examination for adequate bowel preparation.

Intravenous access is obtained preferably with 18 G cannula. Mannitol is used as a neutral oral contrast agent in our study

To improve visualization of the mucosa and achieve better bowel distension, a neutral oral contrast agent (mannitol) is administered. In the present study 2.5% mannitol preparation is used. The mannitol solution is prepared by diluting 125ml of 20% mannitol with 875ml of water to give 2.5% concentration

Patient is asked to drink orally a total of 1 L over 1 hour. Followed by iv buscopan

After the oral contrast agent is ingested, a bolus of intravenous contrast material (150 ml) followed by 50 mL of saline solution is administered with a power injector at a rate of 4mL/sec.

Helical scanning is performed with 128 MDCT with 0.35secondsrotaion speed from the diaphragm to the symphysis pubis, beginning 50 seconds after the administration of intravenous contrast material and includes a single (venous) phase for the evaluation of known or suspected Crohn's disease or dual (arterial

and venous) phases for the evaluation of mesenteric vessels, GI tract bleeding and suspected tumors.

Scanning parameters include a section thickness of 2-2.5mm mm and reconstruction interval of 1-1.5mm. Coronal and sagittal reformatted images are taken. Some of the patients in our study experienced diarrhea after the procedure.

RESULTS AND DISCUSSIONS

In our study, the predominant age group involved in this study was 21-30 yrs constituting 54% (n = 27), followed by 31-40 yrs (n = 13), 41-50 yrs(n = 6) and 51-60 yrs (n = 4).

In our study, the most common gender involved in this study was males, constituting 27 out of 50 patients (54%) , followed by females constituting23 (46%).

71.4% of total tuberculosis were seen in the age group of 21-30 years and 53.3 % of total crohns disease were seen in age group of 21-30 years. 50% of patients with duodenal adenocarcinoma was seen in the age group of 41-50 years and another 50% of patients are seen in age group of 51-60 years. 50% of patients with duodenal lymphoma was seen in age group of 41-50 years and another 50% seen in age group of 51-60 years. 66.6% of patients with mesenteric ischemia were seen in age group of 21-30 years and 33.3% of patients are seen in age group of 31-40 years.

In our study, there were 27 males and 23 females. There was male preponderance in tuberculosis out of 21 patients diagnosed with tuberculosis 15 patients were males and 6 patients were females. There was slight female preponderance in females constituting 8 patients and males constituting 7 patients. There was equal male and female preponderance in duodenal adenocarcinoma. In case of both malabsorbtion and mesenteric ischemia, there were 1 male and 2 female patients.

In our study, majority of the patients were diagnosed as tuberculosis constituting 42% (n = 21), next is crohns disease constituting 30% (n = 15).duodenal adenocarcinoma, duodenal lymphoma constituting 4 cases each and malabsorbtion, mesenteric ischemia constitutes of 3 cases each.

Most common symptom with which the patients presented was pain abdomen constituting 22 patients (44.4%), followed by diarrhea constituting 16 patients (32%), loss of weight in 9 patients (18%), abdominal distension and vomiting both noted in 7 patients (14%), fever in 4 patients (8%) and loss of appetite in 3 patients (6%).

In our study, among 50 patients29 patients showed grade 3 bowel distension, 18 patients showed grade 2 bowel distension and 3 patients showed grade1 distension.

Among the 21 cases of Tuberculosis, the most common segment of small bowel involved was terminal ileum, found in 10 patients (37%), ileo caecal junction in 15 patients (55.5%) and jejunum in 2 patients (7.5%).

In our study, 18% of patients showed target appearance with mural stratification pattern of enhancement. 34% of patients showed homogenous hyper enhancement. 20% of patients showed homogenous and mild enhancement. 16% of patients showed heterogenous enhancement.

In our study, majority of crohns disease patient (n = 9) had target appearance with mural stratification enhancement pattern. Majority of tuberculosis patients(n = 14)had homogenous hyper enhancement. Duodenal adenocarcinoma and duodenal lymphoma had heterogenous enhancement. In our study, out of 21 patients diagnosed with tuberculosis, majority of patients(n = 17) showed segmental (6-40 cm)length of small bowel involvement. Out of 15 patients diagnosed with crohns disease majority of patients(n = 13) showed segmental(6-40cm)length of small bowel involvement

In our present study, out of 21 patients of tuberculosis 16 patients showed asymmetrical thickening of small bowel and 5 patients showed symmetrical thickening of small bowel.

Out of 15 patients of crohns disease, 14 patients showed asymmetrical thickening of small bowel and 1 patient showed symmetrical thickening of small bowel. Both duodenal adenocarcinoma and duodenal lymohoma showed asymmetrical thickening.

In our study, out of 15 patients diagnosed with crohns disease, 10 patients showed mucosal enhancement, 2 patients showed entire wall enhancement, 2 patients showed submucosal enhancement and 1 patient showed serosal enhancement.

Out of 21 patients diagnosed with tuberculosis,15 patients showed entire wall enhancement and 6 patients showed mucosal enhancement. 19 patients of patients with Tuberculosis showed lymphadenopathy, 10 patients showed fibro fatty proliferation and 10 patients showed ascites 10 patients with crohns disease showed fibro fatty proliferation, 5 patients showed stricture, 1 patient showed mesenteric abscess,5 patients showed fistulas and 10 patients showed ascites.

In our present study, sensitivity and specificity of CTE in diagnosing small bowel tuberculosis is 90% and 90% respectively. In our present study, sensitivity and specificity of CTE in diagnosing crohns disease is 75% and 91.1% respectively.

In our present study, sensitivity and specificity of CTE in diagnosing duodenal adenocarcinoma, duodenal

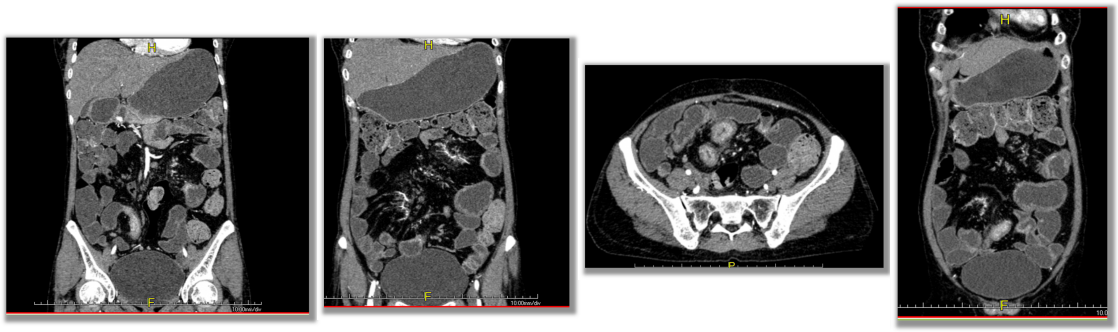

Fig. 1: Coronal and axial CT enterography images showing increased multi segmented mucosal hyper enhancement, wall thickening of ileal loops(skip lesions) and increased mesenteric vascularity(COMB'S SIGN) and fibro fatty proliferation suggestive of crohn's disease

Fig. 2: Assymetrical circumferential wall thickening of pylorus and D1 part of duodenum noted for a length of 4 cm and wall thickness of 19mm causing proximal dilatation of stomach likely carcinoma of pylorus and D1part of duodenum .Histopathological examination revealed adenocarinoma

Fig. 3:There is long segment thickening and enhancement of terminal ileum and ileocaecal junction noted suggestive of ileocaecal tuberculosis

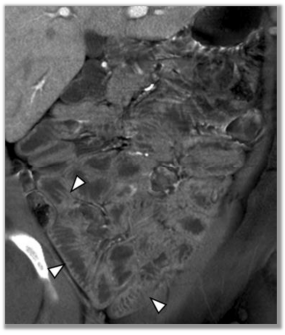

Fig. 4: Coronal CT enterography image showing jejunalization of ileal loops noted in right lower quadrant S/O malabsorbtion

Table 1: Distribution of small bowel lesions according to age in years

Diagnosis	Age in years				
	21-30	**31-40**	**41-50**	**51-60**	**NO**
Tuberculosis	15 71.4%	4 19%	2 9.5%	0	**21**
Crohns disease	8 53.3%	7 46.6%	0	0	**15**
Duodenal adenocarcinoma	0	0	2 50%	2 50%	**4**
Duodenal lymphoma	0	0	2 50%	2 50%	**4**
Malabsorbtion	2 66.6%	1 33.3%	0	0	**3**
Mesenteric ischemia	2 66.6%	1 33.3%	0	0	**3**

Table 2 : Distribution of small bowel lesions

Disease	Number	Percentage
Crohns disease	15	30
Tuberculosis	21	42
Duodenal adenocarcinoma	4	8
Duodenal lymphoma	4	8
Malabsorbtion	3	6
Mesenteric ischemia	3	6

Table 3: Distribution of clinical symptoms among patients

Symptoms	Number of patients	Percentage
Pain abdomen	22	44.4
Abdominal distension	7	14
Loss of weight	9	18
Loss of apetite	3	6
Diarrhea	16	32
Vomitings	7	14
Fever	4	8

Table 3:Site of involvement in tuberculosis

Site	Number	Percentage
Terminal ileum	10	37
Ileo caecal junction	15	55.5
Jejunum	2	7.5

Table 5: Distribution of small bowel lesions according to enhancement pattern

Enhancement pattern	No. of patients	Percentage
Target appearance with mural stratification	9	**18**
Homogenous hyper enhancement	17	**34**
Homogenous and mild enhancement	10	**20**
Heterogenous enhancement	8	**16**

Table 6 : Observed enhancement pattern of small bowel lesions

Disease	Enhancement pattern			
	Target appearance with mural stratification	**Homogenous hyper enhancement**	**Homogenous mild enhancement**	**Heterogenous enhancement**
Crohns disease	9	3	3	0
Tuberculosis	0	14	7	0
Duodenal adenocarcinoma	0	0	0	4
Duodenal lymphoma	0	0	0	4

Table 7: Correlation of CT enterography with histopathological, endoscopic and surgical findings in diagnosing small bowel lesions

Diagnosis	True positive	False positive	False negative	True negative	Total lesions
Tuberculosis	18	3	2	27	50
Crohns	12	3	4	31	50
Duodenal adenocarcinoma	2	2	1	45	50
Duodenal lymphoma	2	2	1	45	50
Malabsorbtion	2	1	2	45	50
Mesenteric ischemia	2	1	2	45	50

Table 8: CT enterography in diagnosis of small bowel lesions statistical representation

Diagnosis	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
TB	90	90	85.71	93.1	90
Crohns	75	91.1	80	88.57	86
Duodenal Adenocarcinoma	66.6	95.7	50	97.8	94
Duodenal Lymphoma	66.6	95.7	50	97.8	94
Malabsorbtion	50	97.8	66.6	95.74	94
Mesenteric Ischemia	50	97.8	66.6	95.74	94

lymphoma is 66.6% and 95.7% respectively. In our present study sensitivity and specificity of CTE in diagnosing malabsorbtion and mesenteric ischemia is 50% and 97.8% respectively.

The cases were evaluated with CT Enterography in the department of Radio diagnosis, osmania general hospital. CT was performed (Single, double or triple phase depending upon the clinical suspicion) performed with 128 slice MDCT with 0.35 seconds rotation speed Images are acquired with a section thickness of 2.0-2.5mm and a reconstruction interval of 1.0-1.5mm. Coronal and sagittal reformatted images are generated at the workstation from the axial images. Diagnosis of small bowel diseases was made on CTE in correlation with clinical symptoms, ileocolonoscopy and biopsy findings.

The mean age was 29 years in a study done by Seung Soo Lee *et al.* in 2009. According to Shauna Duigenon, CD has bimodal first peak in the second or third decade of life and a smaller peak in sixth or seventh decade. there is equal evidence ,however , of a unimodal peak in second or third decade that explains high incidence in the adolescent population. Michael Dam Jensen *et al*, 2011, studied 45 patients and found that the median age was 39 years in the study. Hassan A. Siddiki *et al*, 2009, found that mean age was 39 years in women and 40 years in men for Croh'n disease in their study on 33 patients who underwent CT and MR enterography.

The predominant gender involved in this study was males constituting 27 out of 50 patients (54%). Females constituted 23 patients (46%) of the study population.

Most of the patients presented with pain abdomen (44.4%) constituting 22 out of 50 patients followed by diarrhea (32%). Other symptoms with which the patients presented were loss of weight (18%), abdominal distension (14%), vomitings (14%), fever (8%) and loss of appetite (6%).

In our study, majority of the patients were diagnosed as tuberculosis constituting 42% (n = 21), next is crohns disease constituting 30% (n = 15). duodenal adenocarcinoma, duodenal lymphoma constituting 4 cases each and malabsorbtion, mesenteric ischemia constitutes of 3 cases each.

Kuehle [4]reported that good small bowel distension could be achieved when using 1 l solution of 2.5% mannitol. Maglinte[5] stated that a volume of <1.5 l is unlikely to be sufficient for adequate bowel distension.

Among the 21 cases of Tuberculosis, the most common segment of small bowel involved was terminal ileum, found in 10 patients (37%), ileo caecal junction in 15 patients (55.5%) and jejunum in 2 patients (7.5%). Adequacy of bowel distension was better with CTE, constituting 29 out of 50 cases showing grade 3 distension, 18 cases showing grade 2 and 3 showing grade 1.

Boudiaf [6]classified small bowel distension using a grading system based on diameters of jejunum and ileum graded 0-3 (where 0 for no distension and 3 was for optimal distension.

In a study by Frager DH[12] patients with crohns disease showed target appearance and associated mesenteric fibro fatty proliferation. In a study done by Kale D Bodily[] done in 96 patients quantitative measures of mural attenuation and wall thickness at CTE correlate highly with ileoscopy and histologic findings of active crohns disease. In our study, out of 21 patients diagnosed with tuberculosis, majority of patients(n = 17) showed segmental (6-40cm)length of small bowel involvement. Out of 15 patients diagnosed with crohns disease majority of patients(n = 13) showed segmental(6-40cm)length of small bowel involvement

In a study done by Macari[] pattern approach to abnormal small bowel shows how a systemic pattern like enhancement pattern, mural thickening, symmetry of mural thickening, length of small bowel involvement, involved segment of bowel wall can be used to narrow differentials when abnormal bowel loop is detected on CTE. In our study, all mesenteric ischemic diagnosed cases showed decreased enhancement with mild bowel wall thickness and segmental involvement of bowel

In a study done by Macari[8], among 35 examinations 19 abnormal segments with mesenteric ischemia were identified with mean bowel wall thickness of 4mm, length of small bowel involvement is segmental in in 3 and long in 16and none of them showed target appearance of enhancement and have shown decreased enhancement.

In a study done by EJ Balthazar[9] , on 11 patients with ileocaecal five cases showed mild circumferential mural thickening of terminal ileum, caecum and ileocaecal junction and a few regional lymph nodes. One case presented with bowel obstruction. In other 5 patients showed characteristic ileocaecal wall thickening and thickening of medial wall of caecum noted.

10 patients with crohns disease showed fibro fatty proliferation, 5 patients showed stricture, 1 patient showed mesenteric abscess, 5 patients showed fistulas and 10 patients showed ascites. The life time risk for developing a fistula in patients with crohns disease is between 20% and 40%.

Koh *et al.*, increase in mesenteric vascularity was shown to have a sensitivity of 78% and specificity of 57% in diagnosing active Crohn's disease. Koh *et al.*

described Fibro-fatty proliferation of mesentery adjacent to diseased segments occurs, and usually persists into clinically inactive phases of the disease.

According to Lee[10] 2009 the sensitivity and specificity of CTE for diagnosing active CD was 89% and 80% respectively. The sensitivity of detecting extra enteric complications was 100% for CTE

Schreyer A. G *et al,* found that for small bowel and colon assessment, there was no significant difference for image quality between CTE and MRE. Inflammation diagnosis was not significantly different between CT (69.4%) and MRE (71.4%). Colonic inflammation was diagnosed in 30.2% based on CT and 14.3% based on MRE. The sensitivity and specificity of CTE for detection of small bowel CD 83% and 70% respectively according to Michael Dom Jensen *et al.*

CTE detected small bowel stenosis with 70% sensitivitiy and 92% specificity according to Hassan A Siddiki *et al*. The sensitivity CTE for detecting active small bowel crohn's Disease is 95.2%. Pilleul etal11 (reported a sensitivity of 84.7% and specificity of96.9% for detection of small bowel tumors using CTE. In the present study, CTE can be used to detect active small bowel inflammation, as well as extra enteric complications.

CONCLUSION

It was concluded CT enterography can be used as a method of choice for evaluation of diffuse small bowel pathologies. CT enterography with adequate bowel luminal distension and negative oral and intravenous contrast can be used to detect mucosal enhancement, mural stratification, luminal and extra luminal complications of small bowel pathologies. CT enterography is an excellent technique for evaluation of crohns disease with excellent visualization of mucosal enhancement, mural stratification, extra luminal findings like fibro fatty proliferation, combs sign and other complications such as strictures and fistulas. CT enterography can be used as a method for differentiating active and chronic crohns disease and can be used as a guide for the therapy as most of the active crohns disease were treated medically and chronic crohns disease with fistulas and strictures are treated surgically. CT enterography can also be used for diagnosis of various small bowel pathologies like small bowel adenocarcinoma, small bowel lymphoma, malabsorption and mesenteric ischemia.

REFERENCES

1. Raptopoulos, V., R.K. Schwartz, M.M. McNicholas, J. Movson, J. Pearlman and N. Joffe, 1997. Multiplanar helical ct enterography in patients with crohn's disease.. Am. J. Roentgenol., 169: 1545-1550.
2. Paulsen, S.R., J.E. Huprich, J.G. Fletcher, F. Booya and B.M. Young *et al.,* 2006. Ct enterography as a diagnostic tool in evaluating small bowel disorders: Review of clinical experience with over 700 cases. Radiographics, 26: 641-657.
3. Hara, A.K., J.A. Leighton, V.K. Sharma, R.I. Heigh and D.E. Fleischer, 2005. Imaging of small bowel disease: Comparison of capsule endoscopy, standard endoscopy, barium examination and ct. Radiographics, 25: 697-711.
4. Kuehle, C.A., W. Ajaj, S.C. Ladd, S. Massing, J. Barkhausen and T.C. Lauenstein, 2006. Hydro-mri of the small bowel: Effect of contrast volume, timing of contrast administration and data acquisition on bowel distention. Am. J. Roentgenol., 187: 375-385.
5. Maglinte, D.D.T., K. Sandrasegaran, J.C. Lappas and M. Chiorean, 2007. CT enteroclysis. Radiology, 245: 661-671.
6. Boudiaf, M., A. Jaff, P. Soyer, Y. Bouhnik, L. Hamzi and R. Rymer, 2004. Small-bowel diseases: Prospective evaluation of multi-detector row helical CT enteroclysis in 107 consecutive patients. Radiology, 233: 338-344.
7. Bodily, K.D., J.G. Fletcher, C.A. Solem, C.D. Johnson and J.L. Fidler *et al.*, 2006. Crohn disease: Mural attenuation and thickness at contrast-enhanced ct enterography-correlation with endoscopic and histologic findings of inflammation. Radiology, 238: 505-516.
8. Macari, M., A.J. Megibow and E.J. Balthazar, 2007. A pattern approach to the abnormal small bowel: Observations at mdct and ct enterography. Am. J. Roentgenol., 188: 1344-1355.
9. Balthazar, E.J., M. Noordhoorn, A.J. Megibow and R.B. Gordon, 1997. Ct of small-bowel lymphoma in immunocompetent patients and patients with AIDS: Comparison of findings.. Am. J. Roentgenol., 168: 675-680.
10. Ha, H.K., S.H. Lee, S.E. Rha, J.H. Kim and J.Y. Byun *et al.,* 2000. Radiologic features of vasculitis involving the gastrointestinal tract. Radiographics, 20: 779-794.
11. Pilleul, F., M. Penigaud, L. Milot, J.C. Saurin, J.A. Chayvialle and P.J. Valette, 2006. Possible small-bowel neoplasms: Contrast-enhanced and water-enhanced multidetector ct enteroclysis. Radiology, 241: 796-801.