



Research Article

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Importance of ultrasonography and colour doppler in evaluation of bowel pathology in clinically suspected cases

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Abstract

Background: High resolution ultrasonography and colour doppler have become valuable diagnostic modalities for the evaluation of bowel pathology. Study was done to evaluate importance of ultrasound with colour doppler in bowel pathology arising from duodenum to rectum. **Materials and Methods:** A prospective study of 160 patients was done with bowel pathology during July 2013 to December 2014. The study group consists of patients who presented with clinical signs and symptoms pertaining to pathology arising from the duodenum, small bowel, large bowel and appendages. Detailed history was taken before the sonography examination. **Results:** In our study, out of 160 patients of bowel lesions, 42 patients (26.2%) were under 32 to 40 years age group. Pain in abdomen was the commonest presentation found in 149 patients (93.1%). Infection and Inflammatory lesions were the commonest bowel pathology detected in 109 patients (68.1%), among them appendicitis & its complication was the commonest pathology followed by abdominal tuberculosis. Neoplasm was 2nd most common pathology which constituted 28 patients (17.5%). The commonest malignant lesion was adenocarcinoma diagnosed in 19 patients (70%). **Conclusion:** Ultrasonography (USG) is the primary investigation of choice in the patients with pain in abdomen. The use of endosonography proved to be essential in detecting and staging rectosigmoid malignancy. Hydrocolon technique and fluid aided sonography also helped in delineating colonic masses. High frequency graded compression sonography proved to be essential in case with acute appendicitis.

Keywords: Bowel lesions, I-C junction, USG, Colour doppler, MRI, TRUS.

Introduction

Ultrasonography performed with the help of high-frequency linear transducer, colour doppler and pulse wave doppler modes. USG is the modality of choice for imaging and evaluating bowel pathology, which helps in characterizing bowel lesions, and to suggest specific diagnoses. B-mode gray scale high frequency sonography and color doppler allow excellent visualization of parenchymal changes associated with bowel lesions. High-frequency sonography with colour doppler in its present state can differentiate malignant from inflammatory bowel pathology, acute appendicitis with its complication. Evaluation by color doppler imaging and power doppler may help in differentiation of active bowel thickening (increased blood flow) from chronic wall thickening/ fibrosis (normal or no increased blood flow).^[1] Trans rectal ultrasonography (TRUS) and trans vaginal sonography (TVS) show excellent role in detecting and staging rectosigmoid malignancy. Rectal sonography is not able to resolve the mesorectal fascia but has better differentiation of wall layers than magnetic resonance imaging (MRI) and is therefore indicated in the assessment of early tumour involvement and selecting T1 N0 cases for local excision.^[2] Hydrocolon technique and fluid aided sonography also helped in delineating colonic masses. In pregnancy sonography is stamped as the diagnostic modality to detect both maternal lesions as well as fetal intestinal anomalies.

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Materials and Methods

In our study, 160 patients were selected, who had clinical signs and symptoms of pathology arising from the duodenum to rectum along with its appendages and mesentery. Patients were scanned with the convex probe (2 MHz – 5 MHz) and linear high frequency probe (4 MHz - 9 MHz) on the ultrasound machine Esaote My Lab series. Detailed history and presenting symptoms was evaluated. Study was done during July 2013 to December 2014. Ultrasound was performed on the patient in the supine position. A direct contact scanning technique with the use of the acoustic coupling gel was used and scanning was

done in the sagittal, transverse, coronal and oblique sections. TRUS and or TVS were done in patients with recto-sigmoid lesions. Hydrocolon technique and oral water contrast were used as and when required. We have confirmed our diagnosis by follow up sonography with other radiological and pathological investigation and/ or surgery with histopathology. Patients with clinically suspected bowel pathologies that turned out normal on sonography and patients who could not be followed up to the final diagnosis were not included in our study. Patient with hernia without strangulation or obstruction were excluded from this study.

Result

Table 1: Age of patients

Age group	No of patients	%	No. of Male patients	%	No. of Femalepatients	%
Infants to 10 yrs	5	3.1	3	1.8	2	1.25
11 to 20yrs	14	8.7	8	5	6	3.75
21 to 30 yrs	35	21.8	19	11.8	16	10
31 to 40 yrs	42	26.2	29	18.1	13	8.1
41 to 50yrs	30	18.7	17	10.6	13	8.1
51 to 60 yrs	22	13.7	13	8.1	9	5.6
61 to 70 yrs	9	5.6	7	4.3	2	1.25
71 to 80yrs	3	1.8	2	1.25	1	0.62
Total	160		98		62	

Age of the patients involved in this study, ranged from infants to 80 years old patients. Bowel lesions were commonest in the 31 to 40 years followed by 21 to 30 years of age group. 29 patients (18.1%) were male and 13 patients (8.1%) were female.

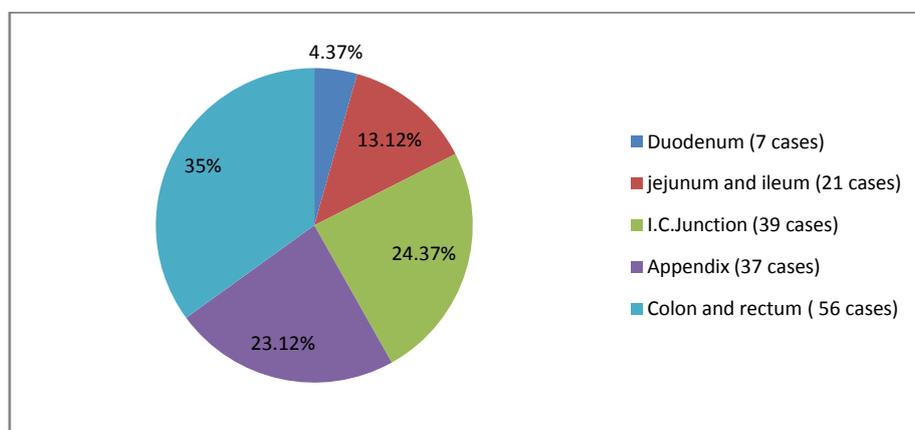
Table 2: Ultrasonographic diagnosis of bowel lesions

	Diagnosis	No of cases	Total patients	%	
1	Congenital	Imperforated anus	2	1.25	
		Malrotation			
2	Infection and inflammation	Tuberculosis	109	68.12	
		Amoebic collitis			
		Enteritis			
		Acute appendicitis & its complications			
		Ulcerative colitis			
		Crohn's disease of ileum			
		Round worms infestations			
		Sigmoid colon Diverticulitis			
		Ischemic collitis			
		Duodenal ulcer with perforation			
		4			Neoplasm
Malignant					
	Leiomyoma in ileum				
	Duodenal carcinoma at ampulla				
	Small bowel Lymphoma				
	Large bowel carcinoma				
Large bowel Lymphoma					
Carcinoid of ileum					
Duodenal Metastasis					
5	Miscellaneous	Obstructive or strangulated hernia	5	3.12	
		Post-op adhesions			3

	Sigmoid volvulus		1	0.62
	Intussusception		12	7.5
			160	100

Infection and Inflammatory lesions were the commonest bowel pathology detected in 109 patients (68.1%). Neoplasm was the second most common pathology seen in 28 patients (17.5%) among them 27 patients had malignancy.

Chart 1: Percentage of involved bowel part



Colon and rectum was the most common site of involvement, involved in 56 patients (35%) followed by I.C junction involved in 39 patients (24.37%).

Table 3: Part of bowel involved

	Bowel	No of patients	%
1	Duodenum	7	4.37
2	I.C junction	39	24.37
3	Jejunum and ileum	21	13.12
4	Appendix	37	23.12
5	Colon and rectum	56	35
		160	100

Cecum and ascending colon was the most common site for malignancy. Out of 16 patients of malignancy, 6 patients (37.5%) had cecum and ascending colon involvement.

Table 4: Distribution of colorectal malignancy

	Type	No of patients (n=16)	%
1	Cecum and ascending colon	6	37.5
2	Hepatic flexure	3	18.75
3	Transverse colon	1	6.25
4	Splenic flexure	2	12.5
5	Rectosigmoid	4	25
		16	100

Lymphadenopathy noted in all the patients (32 patients) of bowel tuberculosis and one patient of crohn's disease. Hepatic metastasis detected by USG in 5 out of 27 patients of malignancy.

Hepatic abscess noted in 14 patients out of 18 patients of amoebic colitis. Ascites were noted in 24 cases of tuberculosis, 6 cases of acute inflammatory and 4 cases of malignancy. Venous thrombosis detected by USG in 2 cases of acute inflammatory and 3 cases of duodenalmalignancy.

Table 5: Ultrasound findings of Bowel pathology and associated findings

	Acute Inflammatory	Chronic granulomatous Inflammatory	Malignant
Intra luminal involvement	9	---	3
Within wall	70	37	27
soft tissue extensionOutside wall	17	7	14
Lymph nodes	19	33	24
Hepatic metastasis	-	-	5
Hepatic abscess	14	-	-
Ascites	6	24	4
Venous thrombosis	2	-	3

Out of 32 cases of bowel tuberculosis, 22 patients had I.C junction koch's among them 4 patients had thickness of 20-30mm while rest 18 patients had thickness less than 20mm. All the patients of small bowel tuberculosis had thickness of less than 20mm. Out of 32 patients of bowel tuberculosis, 23 patients had more than 50mm length of involved segment. In amoebic colitis, majority of patients had thickness of less than 20mm with diameter of 20-50mm and involved segment length was less than 50mm. Most of patients of acute appendicitis & its complications had thickness of less than 20mm and only 3 cases with lump formation had 20-30mm thickness. Out of 6 patients of bowel lymphoma, 5 patients had more than 50mm length of involved bowel. Out of 16 patients of adenocarcinoma, 11 patients had diameter of 20-50mm and 13 patients had more than 50mm length of involved bowel.

Table 6: Thickness, diameter and length of bowel in focal bowel mass lesions

Disease	Number of cases							
	Thick ness of bowel wall			Diameter			length	
	<20 mm	20-30 mm	>30 mm	<20 mm	20-50 mm	>50 mm	<50 mm	>50 mm
Bowel tuberculosis	28	4	0	9	23	0	9	23
Amoebic colitis	15	3	0	0	18	0	14	4
Acute appendicitis & its complications	34	3	0	35	2	0	29	8
Intussusception	8	4	0	4	7	1	7	5
lymphoma	1	3	2	0	4	2	1	5
Adenocarcinoma	2	9	5	0	11	5	3	13
Duodenal malignancy	3	1	0	1	3	0	4	0
Carcinoid tumour	1	0	0	1	0	0	1	0

Table 7: Intestinal obstruction follow up / operative findings

Mechanical obstruction		
	Type	No. of patients
Duodenum	Malignancy	1
Small bowel		
	Tuberculosis	3
	Strangulated/obstructed hernia	4
	Post-operative adhesions	3
Small and large bowel		
	I C koch's	4
	Large bowel malignancy	7
	intussusception	2
	Sigmoid volvulus	1
Adynamic obstruction		
Duodenal perforation and peritonitis		2
		27 (Total)

In present study, 27 patients presented with signs of bowel obstruction, among the 2 patients with duodenal perforation had adynamicobstruction while 25 patients had mechanical obstruction. Out of 25 patients with mechanical obstruction, 7 patients had large bowel malignancy.

Figures:

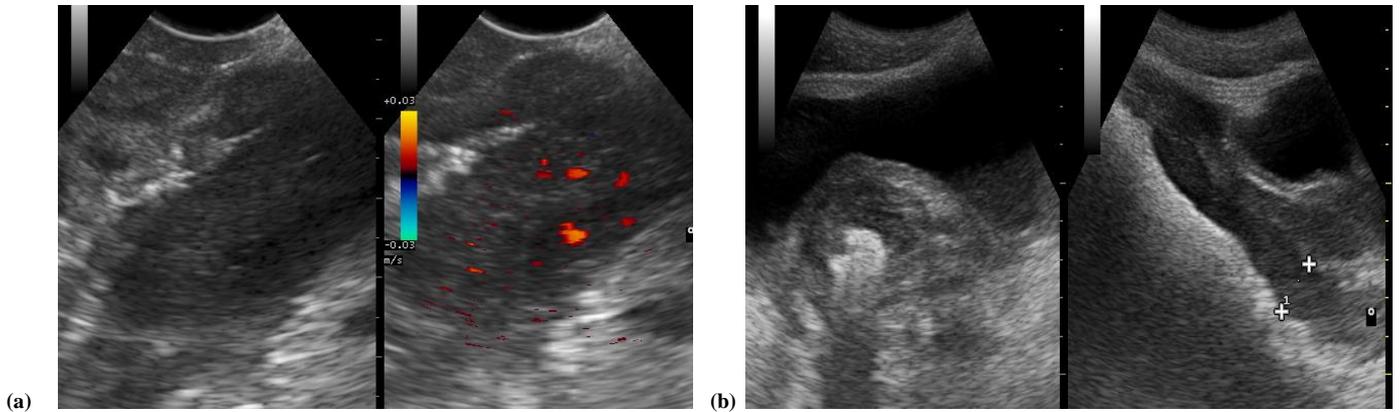


Figure 1(a): Endorectal sonography b-mode and color Doppler and **figure1 (b):** Transabdominal USG: Patient with rectosigmoid mass show marked circumferential thickening of wall of rectum and sigmoid colon with abnormal increase vascularity.

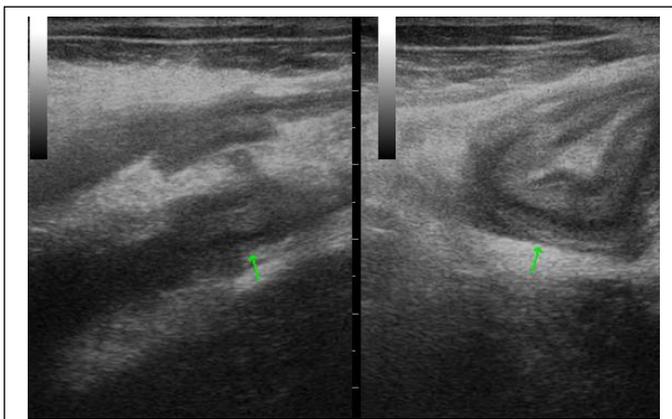


Figure 2: Transabdominal sonography of patient shows marked circumferential thickening of ceacum and ascending colon with preservation of gut signature.



Figure 3: Transabdominal sonography of Crohn's patient shows enterocutaneous fistula with marked circumferential thickening of terminal ileum.

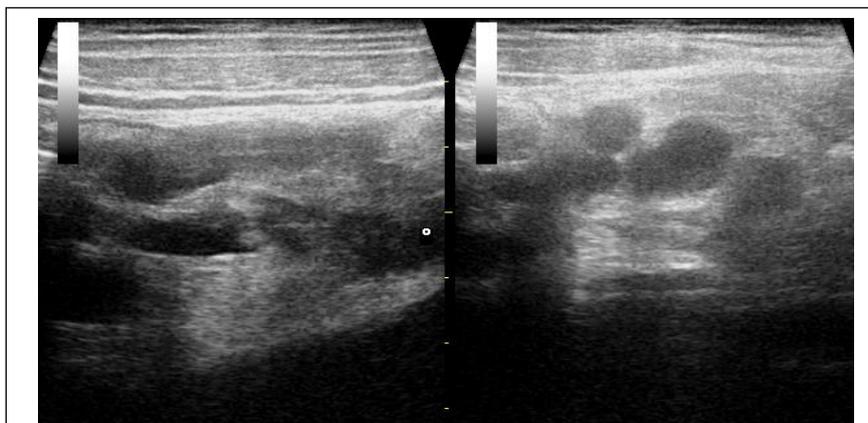


Figure 4: High frequency sonography shows ileocaecal region tuberculosis show thickening of terminal ileum and caecum. Multiple enlarged lymph nodes are seen in RIF.

Discussion

In this study of 160 patients with bowel lesions, the commonest age group was 31 to 40 years (26.2%), followed by 21 to 30 years (21.8%). Among them 29 patients (18.1%) were male and 13 patients (8.1%) were female. Pain in abdomen was the commonest presentation found in 149 patients (93.1%). In our study, the commonest clinical sign was tenderness (134 patients 83.7 %). Out of 160 total patients; large bowel involvement was seen in 56 patients (35 %).

Infection and inflammation

Infection and Inflammatory lesions were the commonest bowel pathology detected in 109 patients (68.1%), out of it appendicitis & its complication(s) was the commonest pathology observed followed by abdominal tuberculosis. Out of 37 cases of appendicitis, the appendicular diameter varied from 6-17mm and wall thickness was from 3-7mm in present study. Out of 37 patients of appendicitis, 11 cases (29.7%) had appendicular complications. Appendicular perforation detected in 4 cases, lump formation seen in 3 cases, 3 patients had mucocele formation and 1 patient had pyocele. Acute appendicitis was the commonest cause of acute abdominal pain requiring surgical intervention.^[3] 32 patients of bowel tuberculosis, Ileo-Caecal (I-C) region was the most common site for tuberculosis noted in 23 patients. All I - C tuberculous lesions were more than 50mm length in this series. This finding was also observed by Priti Shah^[4] but AIIMS (All India Institute of Medical Science) study^[5] which showed most to be of short length involvement (less than 50mm). All I-C tuberculosis lesions were in range of 20-50mm in diameter which is similar to that in AIIMS study.^[5] Out of 32 cases of tuberculosis, all patients had lymphadenopathy, 24 patients had ascites and 6 patients had associated small bowel obstruction.

In our study, 18 patients had amoebic colitis. All presented as pseudo kidney lesion in right iliac fossa. 14 patients had liver abscess. In our study, 11 cases of enteritis were noted, 7 patients had thickening of terminal ileum with lymphadenopathy and splenomegaly was diagnosed as enteric fever. In our study, 2 patients had peritonitis with adynamic small bowel obstruction in USG and they had free gas under dome of diaphragm in erect abdomen radiography. Per operatively they diagnosed as perforated duodenal ulcer.

In our study, 2 patients had Crohn's disease of ileum. Crohn's disease commonly affects the terminal ileum and colon although any portion of gut may be involved.^[6] In present study, USG show marked concentric thickening of terminal ileum in both the cases. One of them had enterocutaneous and enterovesical fistula. Air trapping was noted within the urinary bladder. Patient had undergone computed tomography (CT) scan of abdomen and pelvis for confirmation of diagnosis.

In our study, 2 cases of ulcerative colitis were detected; one of them had rectosigmoid perforation with retroperitoneal collection. The thickening of sigmoid colon was 10mm.

In our study, 1 patient had sigmoid colon diverticulitis. USG of bowel show segmental hypoechoic concentric thickening of

sigmoid colon with bright echogenic foci, posterior acoustic shadowing beyond the thickened gut wall and poorly defined hypoechoic zones that suggest inflamed diverticula with inflamed pericolonic fat. Diagnosis was confirmed on CT scan.

In our study, 79 years old male patient had ischemic colitis. USG showed circumferential hypoechoic wall thickening of splenic flexure with absent – no colour flow on doppler study. Air trapping was seen in portal vein and superior mesenteric vein. Our diagnosis was confirmed on CT abdomen. Ischemic colitis commonly affects the watershed segment of colon and old age patients are more commonly affected.^[7]

Neoplastic lesion

Neoplasm was the 2nd most common pathology which constituted 28 patients (17.5%). Among them 27 patients had malignant lesion. Out of 27 patients of malignancy, the commonest lesion was adenocarcinoma in 19 patients (70%) followed by lymphoma seen in 6 patients (22.2%). This correlates well with Manorama berry et al study.^[8] In our study, 16 cases had colorectal malignancy, among them commonest site of malignancy was caecum and ascending colon seen in 6 cases (37.5%). Endoscopy helped in detecting and staging of the rectosigmoid malignancy, patients were subjected to TRUS and/ or TVS. Out of 4 patients, 3 patients showed no spread beyond the colonic wall and one patient showed invade urinary bladder wall. Two patients had peri-rectal enlarged lymph nodes. All these findings were confirmed on CT scan. The usefulness of endoscopy in staging colorectal malignancy is well reviewed by various authors.^{[9],[10]} Hydrocolon technique helped in demonstrating the extent of colonic malignancy in 4 cases and oral water contrast helped into differentiate between hepatic flexure mass from pyloric and duodenal masses in 3 cases. Usefulness of the technique is observed by Bernd Limberg.^[11] Out of 27 cases of malignant bowel mass, metastatic lymphadenopathy detected in 24 patients by USG and hepatic metastasis detected in 5 cases. In our study, 3 patients had duodenal metastasis which was confirmed on CT scan and histopathology report, among them one patient had primary in head pancreas, one patient had cholangiocarcinoma and third one had contiguous spread through pyloric malignancy. Only one patient had benign lesion leiomyoma of ileum associated with intussusception. One cases of carcinoid tumour were detected in present study but diagnosis was made only on histopathology.

Total 6 cases of lymphoma were detected in present study, among them 4 cases had small bowel lymphoma while 2 cases had large bowel lymphoma. The thickness of the bowel involved varied from 16-35mm. All of them were Non-Hodgkin's lymphoma which correlates well with C. Goerg, W.B.Schwerk et al study.^[12] In his study, 50 out of 54 patients (93%) with bowel lymphoma were Non-Hodgkin lymphoma and the thickness of bowel ranges from 5-40 mm.

In our study, one case of small bowel lymphoma stomach was also involved. All of them show mesenteric and retroperitoneal lymph node enlargement with splenomegaly detected on USG. 3 out of 6 cases show splenic infiltrations in the form of multiple hypoechoic foci in spleen on USG.

Intussusception

In our study, 11 out of 12 cases of intussusception showed pseudo kidney lesion and 3 out of 12 cases showed multiple concentric ring sign. In a study done by Anjali B. kulkarni *et al.*^[13], target sign was seen in 8 out of 12 patients and multiple concentric ring sign in 2 patient. Intussusception is the commonest cause of small bowel obstruction in children between the ages of 6 months to 4 years., There is 100 % Specificity and sensitivity in USG for diagnosis of intussusceptions.^[6]

Obstructive or strangulated hernia

Out of 3 cases of obstructive inguinal hernia, 2 cases showed strangulation.

Post-op adhesions

In our study, 3 patients had small bowel obstruction and they all had operative history of abdominal surgery. Adhesions were difficult to detect with ultrasound.

Sigmoid Volvulus

In our study, one patient presented with acute abdominal pain, in USG there were signs of bowel obstruction with dilated gas filled large bowel loops. But in erect abdominal radiograph of the same patient showed inverted coffee bean appearance in left hypochondrium and we put the diagnosis of sigmoid volvulus that was confirmed in surgery.

Imperforated anus

One new-born child presented with imperforate anus. Transperineal sonography at the site of the anal dimple show fluid filled blind ended pouch, the distance between the skin surface and the blind ending hindgut was 1.4mm measured by sonography. Distance of less than 1.5 mm suggests a low pouch.^[6]

Malrotation

One 5 year old male patient with the history of vomiting had malrotation. Sonography showed reversal of relation of superior mesenteric artery and veins with twisted mesenteric vessels seen swirling in a clockwise direction indicates positive whirlpool sign on colour doppler ultrasound.

Conclusion

Ultrasonography is the initial diagnostic modality of choice of bowel pathology arising from duodenum to rectum. Ultrasonography is the primary screening modality in patient with abdominal pain, nausea and vomiting. Endorectal and endovaginal sonography have excellent role in detecting and staging of early rectosigmoid malignancy. Hydrocolon technique and fluid aided sonography proves to be essential in delineating colonic pathology. The usefulness of high frequency graded compression sonography is very important in the diagnosis of acute appendicitis and its complication. Colour and power

doppler imaging helps in differentiation of active from chronic wall thickening or fibrosis.

Conflicts of interest: Patients coming to our institute GMERS (Gujarat medical education and research society) Sola Medical College and Hospital was referred to the radiology department for getting ultrasound from their respective departments were considered. Identity of the patients was concealed and in our ultrasound images patient's name was not disclosed.

Authors' Contribution: All Authors actively participated in our study.

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