How to Cite:
Patil, Y., Kumar, M., Kharat, A., Lamghare, P., & Gupta, A. (2022). Role of ultrasonography and computed tomography in stomach and bowel diseases. *International Journal of Health Sciences*, *6*(S3), 9422–9430. https://doi.org/10.53730/ijhs.v6nS3.8250

Role of ultrasonography and computed tomography in stomach and bowel diseases

Dr. Yashraj Patil
M.D., Associate Professor, Department of Radio-Diagnosis, Dr. D Y Patil Medical College, Hospital& Research Center, Pune, Maharashtra, India
Email: rayoflight5999@gmail.com

Dr. Mudit Kumar
Third Year Junior Resident, Department of Radio-Diagnosis, Dr. D Y Patil Medical College, Hospital& Research Center, Pune, Maharashtra, India
*Corresponding author email: mkarya709@gmail.com

Dr. Amit Kharat
Professor, Department of Radio-Diagnosis, Dr. D Y Patil Medical College, Hospital& Research Center, Pune, Maharashtra, India
Email: Kharatamit75@gmail.com

Dr. Purnachandra Lamghare
Professor and head, Department of Radio-Diagnosis, Dr. D Y Patil Medical College, Hospital& Research Center, Pune, Maharashtra, India
Email: drlamghare@gmail.com

Dr. Arunima Gupta
Second year resident Department of Radio-Diagnosis, Dr. D Y Patil Medical College, Hospital& Research Center, Pune, Maharashtra, India
Email: hogwartsaru1@gmail.com

***Abstract*---**Background-In this study we compared ultrasound with CT in detecting causes of Common stomach and bowel pathologies such as appendicitis, diverticulitis, volvulus in patients presenting at the department with acute abdominal pain in the majority of cases. Methods- A cross-sectional study was conducted in our institute from September 2019 to August 2021 following approval from the Ethical committee of the hospital. All clinically suspected lesions involving stomach and bowel patients included patients who were clinically evaluated at OPD & the emergency department by the surgeon. All those who fulfilled the inclusion criteria were explained the purpose of the study. After clinical assessment, all consenting patients underwent ultrasound and computed tomography (CT) within a few hours of presentation. Results- A total of 100 patients with stomach

and bowel disorders were studied using ultrasound and multidetector CT scan. 25 patients were diagnosed with appendicular pathologies, 25 cases with primary neoplasms, 18 were abdominal Koch's, 17 were Crohn's disease, 6 were ulcerative colitis, 4 were volvulus, 3 were diverticulitis, 2 were intussusception.Acute appendicitis was the most frequent finding seen in 23 patients. Ultrasound was diagnostic in all except one case. Conclusion- We concluded that the ultrasound was used as an initial modality of choice for the evaluation of the patients. This study showed high sensitivity in cases like acute appendicitis, intussusception, and appendicular mucocele. CT scan is a diagnostic modality of choice in bowel and intestinal disorders. In our study in only two cases, there was a discrepancy among the findings obtained in the final diagnosis. A case of abdominal tuberculosis was diagnosed as Crohn's disease and a case of bacterial colitis was diagnosed as ulcerative colitis. Incidental findings like Meckel's diverticulum and intussusceptions were picked up efficiently on CT scans.

***Keywords*---**USG, CT scan, acute abdomen, sensitivity.

Introduction

Endoscopy remains the main technique for the diagnosis of gastrointestinal (GI) tract diseases because it allows a direct visualisation of the mucosa and the possibility of taking samples for histological analysis. Moreover, in recent years, improvements in endoscopic techniques have also made it possible to use endoscopy for interventions in some diseases of the GI tract. However, endoscopy has some limitations due to its invasiveness and the difficulty of examining the small bowel, and it does not allow the visualisation of extra-intestinal structures that may be involved.[1] For many years, traditional radiological techniques played a crucial role in the diagnosis of small bowel diseases. In the last decades, the introduction of, and improvements in, non-invasive cross-sectional imaging techniques including ultrasound (US), computed tomography (CT), positron-emission tomography (PET) and magnetic resonance imaging (MRI), have changed the diagnostic approach to the GI tract. [2]

The presence of gas and other intestinal content make an assessment of the intestine difficult in ultrasound previously this made endoscopy, magnetic resonance (MR) imaging, Computed Tomography (CT) scan as preferred imaging modalities. Over the past few years, technological advances have improved the ability of ultrasonography to detect and monitor illnesses.3 In this study, we compared ultrasound with CT in detecting causes of Common stomach and bowel pathologies such as appendicitis, diverticulitis, volvulus in patients presenting at the department with acute abdominal pain in the majority of cases.

Materials and Methods

Place of study area

The study was in Department of Radiology & Imaging at Dr. D. Y. Patil Medical College and Hospital, Pimpri, Pune.

Study design

Cross sectional study

Study duration

September 2019 to August 2021

Sample design

- Sample size: 100
- Sampling unit: Sampling unit was “individual”
- Sampling technique: Convenient Sampling technique
- Inclusion Criteria:
  - Clinically suspected lesion of stomach or bowel
- Exclusion Criteria:
  - Patient allergic to iodinated contrast media
  - Pregnant women
  - Patients with chronic renal diseases.

Data collection

A cross sectional study was conducted in our institute from September 2019 to August 2021 following approval from Ethical committee of hospital. All clinically suspected lesion involving stomach and bowel patients included patients were clinically evaluated at OPD & emergency department by the surgeon. All those who fulfilled the inclusion criteria were explained the purpose of study. Details of patient information sheet was explained to them and written consent form (Annexure I) filled before actual participation. After clinical assessment all consenting patients underwent ultrasound and computed tomography (CT) within a few hours of presentation. Ultrasound and CT were independently evaluated by two different blinded observers. To guarantee a blinded evaluation for study purposes, ultrasound was performed first and documented in the case record form. CT was only evaluated after finalizing the ultrasound part of the case record form by another radiologist.

Ultrasound: The following general image characteristics and specific radiological features were recorded: image quality, visualization of the painful quadrant (quadrant of interest), infiltration of mesenteric fat (hyperechoic tissue), free fluid, abscess, free intra-peritoneal air, and fistulas. Image characteristics were assessed per organ: gallbladder, bile duct, liver, pancreas, appendix, gastrointestinal tract, lymph nodes, vascular system, kidneys, and if appropriate,

the female reproductive system. Computed tomography: Different types of CT were used in the participating centers, varying from 16- to 128-slice or more CT. All patients received intravenous contrast medium. The CT was evaluated in the same standardized way as the ultrasound examinations. Approximately the same general image findings and specific radiological features as at ultrasound were assessed for CT and recorded on a digital case record form: image quality, fat infiltration, free fluid etc. All the important intraoperative and post-operative findings. Patients are allowed to leave the study anytime during the course of study if he/she is willing to do so.

Data analysis

Data was done in Microsoft Excel and analyzed using SPSS software 16 version. Quantitative data was presented as means ± standard deviations (SD) and qualitative data was presented as frequency.

Results

Table 1
General characteristics

Age in yrs(mean ± SD)	37.05±17.16 yrs
Male : Female	61 : 39
Large bowel organ disease : Small bowel disease : Appendix : Stomach disease	39 : 32 : 25 : 4
Infective : Neoplastic : Inflammatory : Others	45 : 25 : 23 : 7

Table 2
Sensitivity of test as per organ involved among study sample

Organ involved	USG		CT Scan		Sensitivity (%)	
	Yes	No	Yes	No	USG	CT
Appendix	24	1	25	0	96	100
Large bowel	19	20	37	2	48.72	94.87
Small bowel	15	17	31	1	46.87	96.87
Stomach	2	2	4	0	50	100
Total	60	40	97	3	60	97

Table 3
Sensitivity of test as per type of disease among study sample

Type of diseases	USG		CT Scan		Sensitivity (%)	
	Yes	No	Yes	No	USG	CT
Infective	32	13	44	1	71.11	97.98
Inflammatory	11	12	21	2	47.83	91.30
Neoplastic	13	12	25	0	52	100
Other	4	3	7	0	57.15	100
Total	60	40	97	3	60	97

CT scan was most effective (100%) for diagnosing neoplastic abdominal lesions such as adenocarcinoma, lymphoma and other surgical emergencies like intussusception or volvulus. Infective diseases can be diagnosed on USG or CT scan with more than 70% sensitivity. (table 3)

Table 4
Table showing sensitivity of ultrasound and Computed Tomography as per diagnosis among study sample

Diagnosis	USG		CT Scan		Sensitivity (%)	
	Yes	No	Yes	No	USG	CT
Abdominal Koch's	8	10	17	1	44.44	94.44
Acute appendicitis	22	1	23	0	95.65	100
Appendicular Mucocele	2	0	2	0	100	100
Crohn's disease	10	7	16	1	58.82	94.12
Diverticulitis	0	3	3	0	-	100
Intussusception	2	0	2	0	100	100
Neoplasm	13	12	25	0	52	100
Ulcerative colitis	1	5	5	1	16.67	83.33
Volvulus	2	2	4	0	50	100
Total	60	40	97	3	60	97

Mean age of 100 study sample was 37.05 years (standard deviation – 17.16 years), with the highest 78 years and lowest 7 years, there were 61% males and 39% female. Large bowel organ diseases was (39%) most common among subjects followed by small bowel (32%) & appendix (25%) disease. Stomach diseases was observed in 4% of subjects. Infective diseases was most common among study samples at it was present in 45% of cases, followed by neoplastic (25%) and inflammatory (23%). Other diseases includes surgical emergencies like intussusception, volvulus etc. (table 1). Overall CT scan was more sensitive to detect abdominal diseases than USG (97%, 60% respectively). USG was as sensitive as CT scan to detect appendicular diseases while for the rest of organ it was approximately fifty percent less sensitive than CT scan. (table 2). Overall CT scan was more sensitive to detect abdominal diseases than USG (97%, 60% respectively). USG was as sensitive as CT scan to detect appendicular diseases while for the rest of organ it was approximately fifty percent less sensitive than CT scan. (table 3). CT scan abdomen can detect 100% surgical emergencies like acute appendicitis, intussusception, volvulus etc. CT scan having almost double sensitivity for diagnosis chronic diseases like neoplasms, Crohn’s disease than USG. USG having least sensitivity of 16.67% for diagnosing ulcerative colitis. (table 4)

Discussion

All the patients having bowel and stomach pathologies had an ultrasound and computed tomography was performed. In comparison to CT scan, ultrasound is helped real-time assessment and differentiation of the bowel wall layers especially helpful in Crohn's disease and ulcerative colitis.

Appendix pathologies

In our study, out of 100 patients, 25 patients had appendicular pathologies. Most of the patients had appendicitis; only two patients had appendicular mucoceles. Increased appendicular wall to wall diameter was the most consistent direct sign of appendicitis and was found in all cases. Similarly, Kessler et.al, found that the most accurate direct sign was the appendiceal diameter of 6 mm or more under compression.[4] Indirect signs like mesenteric fat stranding, mesenteric reactive lymphadenopathy were not found in all the cases. Appendicular perforation with abscess was seen in five cases and Computed Tomography was confirmatory in those cases. Out of these five cases, appendicoliths were found in 3 cases. So, in cases of appendicitis appendicoliths can cause appendicular perforation and abscess formation. In one case of appendicular perforation, appendicolith was found in the right iliac fossa and appendicular perforation and abscess formation were present.

In two patients with appendicular mucocele, an ultrasound was done, and confirmation was done on Computed Tomography. The appendix was dilated with minimal wall thickening and anechoic mucous content was seen on ultrasound with mild peri appendiceal inflammatory changes. Computed Tomography (CT) was done in all the cases and was particularly helpful in cases of associated pathologies causing pain in the right half of the abdomen, likely right renal calculus to confirm appendicitis. CT scan also helped in cases of subhepatic and retrocecal cases of appendicitis. Almost all the patients were diagnosed on both ultrasound and CT. Only 1 patient who had appendicitis was given nonspecific findings on ultrasound and was diagnosed on CT. So, all the patients with suspected appendicitis should be screened with ultrasound and then computed Tomography. This is similar to a Comparative study by Arun Kumar et al[5] between Ultrasonography and Computed Tomography was done between September 2018 and September 2020, involving a pool of 75 patients clinically suspected of acute appendicitis who concluded that ultrasound should be initially used to screen all the cases but in cases where it is non-specific CECT should be done as it has an advantage in not only detecting but also providing surgical planning basing on different anatomical locations and ruling out other differentials of right iliac fossa pain.

Meckel's Diverticulitis

Three cases of diverticulitis were seen. In all these cases, pathology was not picked up on ultrasound and non-specific features of mesenteric lymphadenopathy with fat stranding were seen. In one case signs of inflammation were found on CT scan including a blind-ending pouch 2 feet proximal to the ileocaecal junction showing mild wall thickening and reactive lymph nodes. In one case there was perforation and collection seen at the base of the Meckel's Diverticulum. In one case minimal fat standing without any obvious bowel wall thickening was seen; Intraoperatively diverticulitis was diagnosed. All the cases were picked up as an incidental finding as the ultrasound was nonspecific and the CT scan showed high specificity in showing signs of inflammation and in the subsequent diagnosis of the pathology.

Abdominal tuberculosis

Out of 100 cases, 18 cases of abdominal tuberculosis are seen in this study. In all the cases ultrasound and CT scans were done. Out of 18 cases; 8 patients were having classical signs of prominent ileocecal junction thickening, pulled up caecum, and multiple hypoechoic conglomerate necrotic lymph nodes. Ascites and omental thickening were seen in 5 cases. CT scan showed similar findings seen on ultrasound. Clumped, peritoneal thickening and matted bowel loops, and omental caking/caecal spasm were better evaluated on computed tomography. The most specific and consistent sign seen in most cases was ileocaecal junction thickening and multiple enlarged necrotic mesenteric lymph nodes. Similar findings were concluded by a few studies. [6-7]

Inflammatory bowel pathologies
Crohn's disease

Crohn's disease shows prominent circumferential transmural wall thickening and multiple uninvolved intervening skip areas. In total 17 cases of Crohn's disease were there; all had an ultrasound and CT scans. 12 patients were male and 5 patients were female. On ultrasound in 10 cases out of 17 cases; inflammatory bowel disease was given as a differential. On ultrasound bowel wall thickening (more than 5mm), target sign, and extraintestinal features -mesenteric lymph nodes, mesenteric fat stranding were found. Findings in 16 out of 17 cases were picked; in one case instead of Crohn's disease, abdominal tuberculosis was found. On computed tomography- The most consistent finding was transmural circumferential bowel wall thickening seen in 15 out of 17 cases. Other signs were target sign, small bowel feces sign, bowel wall edema, and creeping fat. Complications associated with Crohn's disease were short segment stricture found in 3 cases and abscesses found in 2 cases. These complications can further help in the diagnosis of primary pathology. Ultrasound can help in the anatomical location of the lesions and complications including strictures and abscesses. Similarly, it was concluded by Parente et al and Neye et al [9] that ultrasound can help in the diagnosis of the complications of Crohn's disease.

Ulcerative colitis

About 6 cases of ulcerative colitis were seen. Two patients were male, and four patients were female. In only one case, ultrasound helped in diagnosis and inflammatory bowel disease was given as differential. All the cases were diagnosed on computed tomography. One case that was provisionally diagnosed on CT as ulcerative colitis came out as infective colitis. On ultrasound, there is a characteristic continuous circumferential thickening of the mucosa and submucosa without any involvement of the muscularis layer. Surrounding indirect signs likely mesenteric lymph nodes and mesenteric fat stranding were seen. Bowel wall thickening is the most consistent finding and was seen in all the cases. On Computed Tomography, continuous circumferential bowel wall thickening of loss of normal haustral pattern of the bowel loops, pseudo polyps, ulcers, and mesenteric lymph nodes were seen. Loss of normal haustral pattern was the most consistent finding found in all the cases.

Intussusception

Two cases of intussusception were seen in this study. Both the ultrasound and computed tomography showed characteristic target signs in both cases. In one case there was no lead point; multiple small bowel intussusceptions were seen that got resolved during ultrasound suggesting transient nature. Similarly, JI Hye Kim [10] concluded that without atypical findings, persistent intussusception, and absence of any specific lead point; transient intussusception is considered as provisional diagnosis and conservative management is usually required. In the second case, submucosal lipoma was there at the lead point causing colo-colonic intussusception in the sigmoid colon for which surgical correction was done. Lipoma is a common cause of large intussusception as concluded by Cossavella et al [11] that in 65% of cases lipoma is a cause of intussusception.

Volvulus

A total of four cases of volvulus were seen in this study. Prominently dilated bowel loops are seen so twisting of mesentery and transition point is better seen on the Computed Tomography as compared to ultrasound. In two cases colonic volvulus (sigmoid colon) was seen. While in the other two cases a small bowel was involved. In two cases suspicion of mesenteric torsion was suggested on ultrasound and further CT canvas was advised. While in other cases dilated bowel loops were seen. On computed tomography; classic signs of twisting of the mesentery (whirlpool sign) and counterclockwise barber pole sign(Superior mesenteric vein is distal to its origin is extending posterior and then to the left of SMA- inverse relationship) are likely suggestive of volvulus. A whirlpool sign is seen in all the cases. Counterclockwise barber pole sign is seen in two cases. Coffee Bean sign that is classical of sigmoid volvulus is seen in one case. A similar observation was seen in a study done by Gollub et al [12] Ct swirl sign can predict small bowel volvulus.

Neoplastic disorders

Out of 100 cases, 25 neoplastic disorders were seen. Adenocarcinoma (seen in 18 cases) was the most common finding followed by lymphoma (seen in 5 cases) and a case of small bowel carcinoid. Large bowel (16 cases) was most involved followed by small bowel (5 cases) and stomach(4cases). In about 13 cases; pathology was picked up on ultrasound and asymmetrical bowel wall thickening with necrotic variable-sized lymph nodes was seen. In a few cases; mesenteric thickening was seen. In all the cases CT helped in the evaluation of the extent of bowel involvement, adjacent involved structures, and metastatic lymph nodes.

Conclusion

In our study, ultrasound was used as an initial modality of choice for the evaluation of the patients. This study showed high sensitivity in cases like acute appendicitis, intussusception, and appendicular mucocele. CT scan is a diagnostic modality of choice in bowel and intestinal disorders. In our study in only two cases, there was a discrepancy among the findings obtained in the final diagnosis. A case of abdominal tuberculosis was diagnosed as Crohn's disease

and a case of bacterial colitis was diagnosed as ulcerative colitis. Incidental findings like Meckel's diverticulum and intussusceptions were picked up efficiently on CT scans.

References

1. Prasad H, Rodrigues G, Shenoy R. Role of ultrasonography in nontraumatic acute abdomen. Int J Radiol. 2007;5(2):1-4.
2. Thakur JK, Kumar R. Epidemiology of acute abdominal pain: a crosssectional study in a tertiary care hospital of Eastern India. Int Surg J 2019;6:345-8.
3. Puylaert JB. Ultrasonography of the acute abdomen: gastrointestinal conditions. Radiol Clin North Am. 2003;41:1227–1242.
4. Kessler N, Cyteval C, Gallix B, Lesnik A, Blayac P-M, Pujol J, et al. Appendicitis: evaluation of sensitivity, specificity, and predictive values of US, Doppler US, and laboratory findings. Radiology. 2004 Feb;230(2):472–8.
5. Kumar, B. A., Mohapatra, M., Sekhar Mohanty, S., Sen, K. K., & G, M. K. (2021). Diagonstic performance of ultrasonography and computed tomography in acute appendicitis in tertiary care centre. International Journal of Health and Clinical Research, 4(1), 143–149.
6. Bentley G, Webster JH. Gastro-intestinal tuberculosis. A 10–year review. Journal of British Surgery. 1967 Feb;54(2):90-6.
7. Paustian FF. Tuberculosis of the intestine. Gastroenterology. 1964;11:311.
8. Parente F, Greco S, Molteni M, Anderloni A, Maconi G, Porro GB. Modern imaging of Crohn's disease using bowel ultrasound. Inflammatory Bowel Diseases. 2004 Jul 1;10(4):452-61.
9. Neye H, Ensberg D, Rauh P, Peitz U, Mönkemüller K, Treiber G, Klauck S, Malfertheiner P, Rickes S. Impact of high-resolution transabdominal ultrasound in the diagnosis of complications of Crohn's disease. Scandinavian journal of gastroenterology. 2010 Jun 1;45(6):690-5.
10. Kim JH. US features of transient small bowel intussusception in pediatric patients. Korean journal of radiology. 2004 Sep 1;5(3):178-84.
11. Cossavella D, Clerico G, Rosato L, Galetto PV, Paino O, Trompetto M, Luc AR, Pozzo M. Lipoma of the colon as an unusual cause of recurring partial intestinal occlusion. Clinical case and review of the literature. Minerva chirurgica. 1998 Apr 1;53(4):277-80.
12. Gollub MJ, Yoon S, Smith LM, Moskowitz CS. Does the CT whirl sign really predict small bowel volvulus?: Experience in an oncologic population. Journal of computer assisted tomography. 2006 Jan 1;30(1):25-32