

Role of Abdominal Ultrasonography in Evaluation of Small and Large Bowel Lesions

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Abstract

Background: Ultrasonography [US] has been undervalued in most diagnostic imaging departments for assessing gastrointestinal [GI] illness. Until recently, ultrasound was only used to examine the rectum, anal sphincters, and surrounding tissues through endorectal or endovaginal imaging, and for the diagnosis of appendicitis. The purpose of this research was to evaluate the use of abdominal ultrasonography for detecting lesions in the gastrointestinal tract. Methods: This cross-sectional study was carried out in Benha University Hospital and Al-Ahrar teaching Hospital. 100 patients known to have intestinal diseases or with intestinal complaint. The duration of the study ranged from 6-12 months. Results: Final diagnosis of the different patients is illustrated in table [3]. Appendicular lesions were the most common findings in 31 patients [31%]; acute appendicitis in 20 patients [20%], appendicular abscess in 7 patients [7%] and mucocele of appendix in 4 patient [4%]. Tumours were detected in 26 patients [26%] of patients; colonic carcinoma in 26 patients [26%]. The Ultra-Sound findings of appendicitis were dilated tubular structure in 31 patients, non-compressible in 31 patients, aperistaltic structure in 31 patients, seen in the right iliac fossa region in 31 patients, adjacent free fluid in 21 patients, appendicular mass in 7 and Fecolith in 3 patient, no detected gangrenous appendicitis. The Ultra-Sound findings of the neoplastic lesions were abnormal internal vascularity in 20 patients, circumferential wall thickening seen in 17 patients, lumen narrowing seen in 17 patients only and polypoidal mass seen in 26 patients. Conclusion: Ultra-Sound is applicable in emergency diagnosis in cases of acute abdomen. Ultra-Sound has high diagnostic accuracy as confirmed with operative finding and / or histopathology and follow up. Ultra-Sound cause no health problems and can be repeated if medically indicated.

Key words: Abdominal Ultrasonography and Small and Large Bowel Lesions.

1. Introduction

Ultrasound examination is an easily accessible, non-invasive, radiation-free, and cheap imaging modality that is often chosen as the first diagnostic method in gastroenterology. Many factors can interfere with bowel assessment by US as the patient's body habitus, gas-related artifacts and the overlying intraluminal gases [1].

Computed tomography [CT] is often the modality of choice for imaging of patients with gut-related disease. However, the use of ionizing radiation is a concern, particularly in pregnant women and young patients and those who require multiple repeated CT examinations during recurrent exacerbations of their underlying conditions or for monitoring [2].

Unlike CT, US are considered a safe, inexpensive, widely available, noninvasive method for evaluating the bowel without the use of ionizing radiation [3].

Improvements in ultrasonography technology and the growing expertise of doctors have made intestinal ultrasound a crucial tool in the diagnosis of gastrointestinal disorders [4].

The parameters of intestinal motility may also be evaluated with the use of sonography, another real-time imaging method. When combined with gray-scale data and clinical complaints, Color Doppler US may be a valuable tool for assessing mural vascularity in bowel illness [1].

The intestinal ultrasound examination also involves the assessment of bowel wall thickness, symmetry, luminal diameter, the echogenicity of intestinal layers, haustration, intestinal motility, presence of perivisceral fluid, inflamed perivisceral fatty tissue and enlarged mesenteric lymph nodes [5].

Abdominal ultrasound has been well established for the evaluation of bowel pathology in children as intussusceptions, appendicitis, and hypertrophic pyloric stenosis. Ultrasound of the bowel is a routine part of the evaluation of both adults and children with inflammatory bowel disease. Ultrasound also may be valuable in detection and diagnosis of other disease such as necrotizing enterocolitis [NEC], Henoch-Schönlein purpura [HSP], foreign bodies, and polyps. However ultrasound has a limited role in the workup of other lesions as bowel neoplasms, infections, and celiac disease [6].

The aim of this work was to assess the role of abdominal ultrasonography in imaging of small and large bowel lesions.

2. Patients and Methods

Patients

The study will be carried out in Benha University Hospital and Al-Ahrar teaching Hospital. 100 patients known to have intestinal diseases or with intestinal complaint.

Inclusion criteria

- Both sexes.
- Any age group.
- Patient with known intestinal diseases diagnosed by other imaging modalities e.g. Endoscopy, CT or MRI.
- Patients with intestinal complaint such as [abdominal pain, constipation, altered bowel habits, melena and weight loss] especially those who have risk of exposure to ionizing radiation e.g. young patients and pregnant females.

Exclusion criteria

- Patients with poor ultrasound image quality.

Equipment

- Company: General Electric [GE] healthcare.
- -Model : LOGIQ P5
- -Curvilinear probe [3.5–5 MHz].
- -Higher frequency probe [7-12 MHz].
- Mode :
- B-Mode Gray scale.
- Doppler [color and power].

Patient's preparation

- Patients are required to be fasting for solids at least 4 hours before examination.

- Oral intake of sufficient amount of water to help to distend the small and large bowel loops and the bladder.
- Patients are not advised to consume carbonated drinks to decrease air in the bowel.

Patients included in the study will be subjected to the following :

Full History taking

- Personal history [age, occupation and special habits].
- Patient's complaint e.g. [onset of pain, bowel habit and others].
- Family history.
- Past history of previous treatment or surgical operations.

Trans-abdominal ultrasound

- Gray scale B-mode and Doppler.

Ethical considerations

Before any data is collected or imaging procedures are performed, all participants and parents of young patients [younger than 18] will give their informed consent.

The consent should contain

- Patients are given a straightforward summary of the study's purpose.
- Nothing that may be considered damaging will be done.
- We treat all information as strictly private.
- All samples will be strictly utilised for scientific purposes.
- The findings of the research will be shared with all participants.
- Participants' signatures or fingerprints will be collected.

3. Results

Table (1): Final diagnosis in 100 patients

Type of the disease	No. of ptn	[percentage]
Appendicular lesions	Acute appendicitis	20 [20%]
	Appendicular abscess	7 [7%]
	Mucocele of appendix	4 [4%]
Tumors	Colonic carcinoma	26 [26%]
Intestinal Obstruction	2ry to surgical adhesions	4 [4%]
	2ry to intestinal volvulus	3 [3%]
	2ry to Strangulated hernia	3 [3%]
	2ry to intestinal mass	3 [3%]
Inflammatory diseases	Crohn's disease	7 [7%]
	Diverticulitis	7 [7%]
	Colitis	3 [3%]
intussusception	intussusception	7 [7%]
Total	100	[100%]

Final diagnosis of the different patients is illustrated in table [1]. Appendicular lesions were the most common findings in 31 patients [31%]; acute appendicitis in 20 patients [20%], appendicular abscess in 7 patients [7%] and mucocele of appendix in 4 patients [4%]. Tumours were detected in 26 patients [26%] of patients; colonic carcinoma in 26 patients [26%].

Intestinal Obstruction was present in 13 patients [13%] and it was secondary to the

following cause's surgical adhesions, mesenteric volvulus, strangulated hernia and intestinal mass.

Inflammatory diseases were detected in 17 patients; Crohn's disease in 7 patients [7%], diverticulitis in 7 patients [7%] & ischemic colitis in 3 patients [3%]. Intussusception was detected in 7 patients [7%].

Final diagnosis is reached by operative finding and / or histopathology and follows up.

Table (2): Ultra-Sound finding in patients with Colonic carcinoma.

Ultra-Sound Finding	No. of ptn	Percentage
Abnormal Internal Vascularity	20	20 %
Circumferential Wall Thickening	17	17%
Lumen Narrowing	17	17%
Polypoidal Mass	3	3%

The Ultra-Sound findings of the neoplastic lesions were abnormal internal vascularity in 20 patients, circumferential wall thickening

seen in 17 patients, lumen narrowing seen in 17 patients only and polypoidal mass seen in 26 patients.

Table (3) :Main presenting symptoms in 100 patients.

Symptoms	No. of ptn	percentage
Vomiting	33	33%
Right Iliac Fossa Pain	20	20%
Acute Abdomen	13	13%
Weight Loss And Anorexia	10	10%
Fever	7	7%
Red Currant Jelly Stool	7	7%
Constipation	3	3%
Diarrhea	3	3%

Presenting symptoms show that vomiting was the most common symptom in 33 patients [33%] of the patients followed by pain in the right iliac fossa in 20 patients [20%]. Acute

abdomen was the finding in 13 patients [13%] and weightloss in 10 patients [10%].

High grade fever and red currant jelly stool were detected in 7 patients each. Constipation and diarrhea were detected only in 3 patients.

Table (4): Analysis of the site of the lesion in the 100 patients.

Site of lesions	No. of ptn	percentage
Small intestine	33	33 %
Large Intestine	33	33 %
Appendix	34	34 %

The different sites affected in this study are shown in table [4]., Small intestine in 33

patients [33%], Large Intestine in 33 patients [33%] and Appendix in 34 patients [34%].

Table (5): Ultra-Sound finding in 31 patients with appendicitis.

Ultra-Sound Finding	No. of ptn
Dilated Tubular Structure	31
Non Comprisable	31
Aperistaltic	31
Site in RIF Region	31

Table (3) Continue

Adjacent Free Fluid	21
Appendicular Mass	7
Fecolith	3
Absent Vascular Flow	0

The Ultra-Sound findings of appendicitis were dilated tubular structure in 31 patients, non-compressible in 31 patients, aperistaltic structure in 31 patients, seen in the right

iliac fossa region in 31 patients, adjacent free fluid in 21 patients, appendicular mass in 7 and Fecolith in 3 patients, no detected gangrenous appendicitis.

Table (6): Ultra-Sound finding in 12 patients with intestinal obstruction.

Ultra-Sound Finding	No. of ptn	Percentage
Dilated Intestinal Loops	12	12%
Active Peristalsis	12	12%
Hernial Sac	3	3%
Intestinal Mass	3	3%
Intestinal Volvulus	3	3%
Free Fluid Seen in Between The Loops	3	3%
Thicken Edematous Intestinal Wall	0	0%
Absent Peristalsis	0	0%

The Ultra-Sound findings in patients of obstruction included dilated intestinal loops in 12 patients, active peristalsis in 12 patients, intestinal volvulus in 3 patient, intestinal

mass in 3 patient, hernial sac seen in 3 patient, extra luminal free fluid seen in between the loops in 3 patient. No cases with chronic obstruction.

Table (7): Ultra-Sound finding in 7 patients with intussusception.

Ultra-Sound Finding	No. of ptn
Doughnut Sign	7
Pseudokidney Sign	7
Adjacent Free Fluid	7
Lymph Nodes Inside	4
Abnormal Vascularity	0

The Ultra-Sound finding in the patients of intussusception as detected by US includes, doughnut sign seen in 7 patients, pseudo kidney sign seen in 7 patients, adjacent free

fluid seen in 7 patients, lymph node seen inside as predisposing factor in 4 patient, no detected abnormal vascularity.

**Fig (1) Appendicitis 1**

4. Discussion

Diameters more than 8 mm provided the best diagnostic accuracy for appendicitis, whereas those less than 6 mm accounted for just 2.5% of cases. The target sign, appendicolith, and hypervascularity with Doppler ultrasonography are further evidence for the diagnosis of acute appendicitis. Ultrasound imaging shows an appendicular tumour or abscess as a localised accumulation of complicated fluid that looks identical to a perforated bowel neoplasm. Acute appendicitis may be diagnosed using ultrasonography by a trained examiner. A cordlike formation in the right iliac fossa that lacks peristalsis and is rounder than 6 mm in diameter and typically filled with fluids is a classic ultrasonography hallmark of acute appendicitis [7].

Our findings are consistent with theirs; appendicular lesions were the most prevalent diagnosis in 31 of the patients [31%] in our investigation. This included 20 cases of acute appendicitis, 7 cases of appendicular abscess, and 4 cases of mucocele of appendix [4 percent]. In this study, Ultrasound detected dilated tubular structure in 31 patients, non-compressible structure in 31 patients, aperistaltic structure in 31 patients, right iliac fossa location in 31 patients, adjacent free fluid in 21 patients, appendicular mass in 7 patients, and Fecolith in 3 patients, but no gangrenous appendicitis.

Our results were in agreement with **kuzmich et al.**, [8] who stated that on ultrasound, an appendix tumour or abscess seems as a confined mass of complicated fluid that is hard to tell apart from a perforated intestinal neoplasm.

In accordance with our results study of **Smerczyński & Kołaczyk**, [5] according to their findings, a cord-like structure in the right iliac fossa, with no peristalsis, a circular form of over 6 mm in diameter, typically filled with fluids, is a classic ultrasonography marker of acute appendicitis. The intestinal wall's layer structure may be destroyed by a rapidly progressing and deeply infiltrating illness, making perforation more likely. The presence of a faecal stone is another indicator of acute appendicitis, seen in around 33% of patients. Perforation of the appendix manifests sonographically as a localised reduction in echogenicity and the presence of fluid or gas in the area around the appendix. The development of an abscess is often the result of this condition. Increased blood flow, a hallmark of appendix inflammation, may be seen with the use of power Doppler and colour Doppler imaging[9].

Adenocarcinomas, like other bowel cancers, present as hypoechoic masses at US because they lack the typical mural stratification. Depending on the degree of luminal constriction, a focal tumour may present as a brief segment of thickened annular wall or a polypoid lesion, which may be linked with superficial ulcerations or intestinal obstruction. Diffuse mural thickening and reduced peristalsis may be the result of tumour invasion through or along the gut wall. A huge, well-defined, mostly solid mass with varying echogenicity is one of the US characteristics of GISTs. In rare situations, a substantial echogenic rim is present. Areas of central hypoechoic echogenicity, related to necrosis, may also be seen. [10].

Our findings in this investigation are consistent with theirs. Twenty-six individuals, or 26%, were found to have tumours, 20 of them had colonic cancer. Ultrasound examination revealed polypoidal mass in 26 individuals, circumferential wall thickening in 17, and lumen constriction in 17. Twenty patients had aberrant internal vascularity.

In accordance with our results, study of **Gandhi et al.**, [11] According to their data, neoplasms were the second most prevalent pathology among their sample of 28 patients [17.5%], 27 of them were diagnosed with malignancy. Adenocarcinoma was the most prevalent malignant tumour in 19 of the 27 malignant patients [or 70%], followed by lymphoma in 6 cases [22.2 percent]. Patients who had endosonography performed for rectosigmoid malignancy had transrectal ultrasonography [TRUS] and/or transverse sigmoidoscopy [TVS] for staging. One patient had invasion into the urinary bladder wall, whereas the other three individuals exhibited no dissemination beyond the colonic wall. Two individuals reported swollen lymph nodes around their rectoscopes. The CT scan verified all of these findings. Endosonography has been evaluated extensively by several writers for its use in the staging of colorectal cancer. Oral water contrast helped separate hepatic flexure mass from pyloric and duodenal masses in 3 instances, while the hydrocolon method showed the degree of colonic cancer in 4 cases. USG found metastatic lymphadenopathy in 24 of the 27 instances with malignant intestinal mass, and 5 of the 27 cases showed hepatic metastasis. One patient had initial pancreatic cancer, another had cholangiocarcinoma, and the third had contiguous spread via pyloric malignancy, all of which were verified on CT scan and histopathological report in their study of patients with duodenal metastases. Intussusception was accompanied by the

benign lesion leiomyoma of the ileum in just one case. Histopathology alone was used to diagnose a single instance of carcinoid tumour in the current investigation.

In **Gandhi et al.**, [11] In the current investigation, a total of 6 instances of lymphoma were found, 4 of which were small bowel lymphoma and 2 of which were large bowel lymphoma. The affected bowel thickness ranged from 16mm to 35mm. The cancers were all NonHodgkin's lymphomas. They found that between 5 and 40 mm of gut thickness is associated with non-Hodgkin lymphoma, and that 50 of 54 individuals with bowel lymphoma [93%]. On USG, everyone seems to have splenomegaly and enlarged lymph nodes in the mesenteric and retroperitoneal regions. Multiple hypoechoic foci in the spleen are seen on USG in 3 of the 6 patients, indicating splenic infiltrations.

Normal ultrasound appearance of intestinal obstruction varies with timing of imaging. During the acute phase, the bowel contracts quickly, pushing the contents back and forth, and the intestinal lining is highly porous. The signs of a worsening obstruction include aperistalsis of the bowel and perhaps wall thickening and edoema. If an obstruction is detected by US, the diameter of the intestine distal to the obstructing lesion is often less than that of the more proximal loops. However, the degree of the obstruction determines the quality of the loops distal to the obstructive lesion. Ultrasound has a 97 percent sensitivity and a 93 percent specificity for diagnosing small intestinal blockage. [12]. Their results are congruent with ours in this inquiry. Thirteen patients were diagnosed with intestinal obstruction; the most common reasons were surgical adhesions, mesenteric volvulus, strangulated hernia, and intestinal mass [13 percent]. Hernial sacs were apparent in three patients, extra luminal free fluid was seen in between the loops in three patients, and dilated intestinal loops and forceful peristalsis were present in twelve patients with blockage. No persistent obstructions have occurred.

In a study conducted by **Dietrich and Braden** [13] US findings on intestinal blockage vary on how soon after the beginning of symptoms the scan is performed, it was discovered. In the first, acute phase, the intestinal lining is very permeable, and the bowel undergoes hyperperistalsis, in which the contents move back and forth rapidly. Bowel aperistalsis with possible wall thickening and edoema as blockage progresses. It's common for the loop of intestine furthest from the obstructing lesion to be wider than the section of bowel closer to the obstruction.

In the study of **Gandhi et al.**, [11], out of 3 cases of obstructive inguinal hernia, 2 cases showed strangulation.

Also, **Ünlüer et al** [14] reported that US examination showed a sensitivity of 97.7% and a specificity of 92.7% in diagnosis of small bowel obstruction.

The intestinal wall's structural integrity is compromised in inflammatory bowel disorders. The intestine wall seems thicker, hypo elastic or stiff, and luminal constriction may be seen in Crohn's disease, which is characterised by transmural inflammation that can include many different regions of the gastrointestinal system. Diverticulitis may show up at varying degrees in the United States. At this stage, the colon's wall thickens locally, but there's often no fuzziness in the layers. The fecolith is surrounded by inflammatory mesentery and omentum, which appear as hyperechoic, non-compressible tissue. This inflammatory fat is usually present in diverticulitis and is best recognised under mild, intermittent compression with the transducer. The area of greatest soreness often coincides with the inflamed diverticulum. Diagnostic accuracy of ultrasonography, computed tomography, and magnetic resonance imaging for acute colonic diverticulitis: a comprehensive review. Based on the information available at the time, they determined that ultrasonography should be the first option for diagnosing acute diverticulitis. Ultrasound and computed tomography scans have comparable sensitivity and specificity for the diagnosis of acute colonic diverticulitis [92 percent and 90 percent for ultrasound compared with 94 percent and 99 percent for CT scan consecutively]. An extensive prospective analysis of 802 individuals with acute abdomen corroborated this[15].

Our findings in this investigation are consistent with theirs. Seven individuals with Crohn's disease, seven patients with diverticulitis, and three patients with ischemic colitis were found to have an inflammatory bowel disease [3 percent]. Seven patients had intussusception diagnoses [7 percent]. Follow-up and/or histology results from an operation provide the definitive diagnosis. The Ultrasound findings of IBD include: wall thickening in 17 patients, lumen narrowing in 17 patients, free fluid in the peritoneum in 17 patients, echogenic adjacent fat planes in 17 patients, and associated lymphadenopathy in 3 individuals.

In the study of **Calabrese et al.**, [16], Crohn's disease [CD] causes a thickening and enhanced vascularization of the 4–15 mm of intestinal wall that is affected. Power-Doppler

was an effective tool for gauging the severity of an illness. The intestinal wall is rigid, the adipose tissue around the intestine has a hyperechogenic response, the small intestine has less peristalsis, the colon has no haustration, and there is inflammatory infiltration around the damaged area of the bowel. Mesenteric lymph nodes are swollen in conjunction with these findings. Possible CD problems including stenosis, perforation, abscesses, and fistulas may also be detected by intestinal ultrasonography.

In addition, **Strobel et al.**, [17] showed that ultrasonic imaging of ulcerative colitis [UC] patients often reveals intestinal wall thickening despite the disease's mucosal pathology. However, most individuals maintain bowel wall stratification owing to the disease's superficial nature.

Doughnut sign was observed in 7 patients, pseudo kidney sign in 7 patients, adjacent free fluid in 7 patients, lymph node seen within as predisposing factor in 4 patients, and no detectable aberrant vascularity was found in patients with intussusception.

Our results were supported by study of **Gandhi et al.**, [11], 11 out of 12 instances of intussusception were found to have pseudo kidney lesion, and 3 out of 12 cases were reported to have multiple concentric ring sign.

In a study done by **Anjali & kulkarniet.**, [18] Eight of the 12 patients showed the goal sign, while two had numerous concentric ring signs. In children aged 6 months to 4 years, intussusception is the most prevalent cause of small intestinal obstruction, and USG has a 100% specificity and sensitivity rate for detecting intussusces.

Presenting symptoms in the current investigation indicated that vomiting was the most prevalent symptom in 33 patients [33%], followed by pain in the right iliac fossa in 20 patients [7% of whom experienced projectile vomiting due to HPS] [20 percent]. Thirteen patients [13% of total] were found to have an acute abdomen, and ten patients had a loss of weight [10 percent]. Seven individuals were found to have high-grade fever, and red currant jelly stool was found in two others. Only three individuals had symptoms of constipation or diarrhoea.

However, in the study of **Gandhi et al.**, [11], In 149 individuals, abdominal discomfort was the most prevalent symptom [93.1 percent]. They found that soreness was the most often occurring clinical symptom [134 patients 83.7 percent].

Our data show that 33 patients [33%] had problems with their small intestine, 33 patients [33%] had problems with their large intestine,

and 34 patients [34%] had problems with their appendix [34 percent].

In contrary to our results, study of **Gandhi et al.**, [11] According to their findings, 35% of the patients had involvement in the colon and rectum, while another 39% had involvement in the I.C. junction [24.37 percent]. Most cancers occurred in the cecum and ascending colon. Six of the sixteen malignant patients [37.5%] had cancer that spread to the ceacum and ascending colon.

5.Conclusion

Ultra-Sound is applicable in emergency diagnosis in cases of acute abdomen. Ultra-Sound has high diagnostic accuracy as confirmed with operative finding and / or histopathology and follow up. Ultra-Sound cause no health problems and can be repeated if medically indicated.

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