Original Article

Sonographic Journey For the Detection Of Gastrointestinal MassEs from Distal Esophagus to Rectum with Histological Correlation

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Objective: To demonstrate the sonographic features of gut masses detected either incidentally or purposely through the gastrointestinal tract sonography with histological correlation to compare the detected abnormalities for their benign and malignant nature.

Material and Methods: The study was conducted between September 2009 and February 2013. Ultrasound scanning was performed on 72 patients (20-75 years, mean age 46 years) presenting with clinical suspicion of underlying primary gastrointestinal pathology due to abdominal symptoms. The histological confirmation was done either through surgically resected specimen, trucut biopsy, flexible endoscopic biopsy or fine needle aspiration.

Results: Out of 72 patients, upper GI tract masses included 2 distal esophageal and 7gastric cancers. Mid gut included 9 cases of primary small bowel lymphoma. Intussusception was found in 6 patients. Ileoceacal masses were found in 13 patients with one case of jejunal mass. 18 patients were diagnosed as acute appendicitis, 3 patients demonstrated appendicular mass. Large intestine revealed a single case of diverticulitis besides 15 cases of colorectal cancer. The masses were either lobulated or revealed a segmental wall thickening simulating appearance of kidney (Pseudokidney sign), or diffused wall thickening (Target sign).

Conclusion: In our experience, ultrasonography of the gastrointestinal tract is an extremely useful modality for evaluating gut masses from distal esophagus up to rectum. Sonographic appearance ofgut related masses helps to evaluate the clinical differential diagnosis. However, additional work-up may be needed in the form of contrast study, cross-sectional imaging or endoscopy for specifying the diagnosis with histological confirmation.

Keywords: Ultrasonography, gastrointestinal tract, bowel related masses, histology.

Introduction

Transabdominal ultrasound is often the initial imaging modality performed in most of the patients with abdominal pain or vague symptoms related to the gastrointestinal tract. An awareness of the sonographic appearances of intestinal pathology is essential to reach proper diagnosis and to proceed for an appropriate management plan. Pathological processes affecting the gastrointestinal tract generally cause decreased peristaltic activity and gut wall thickening. A commonly held belief is that bowel gas and peristalsis interfere with sonographic evaluation of the intestine.[1] Although this may be true in the normal state, the diseased intestine typically has a thickened wall, a narrowed lumen, and decreased peristalsis, allowing evaluation of the diseased intestine in most patients. Abnormal lesions may appear as fungating mass with eccentrically located bowel lumen (pseudokidney sign) or symmetrical or asymmetrical, encircling thickening of the colonic wall (target sign).[2]

Transabdominal and transpelvicsonography is useful in diagnosing infectious and inflammatory conditions, i.e. acute appendicitis, diverticulitis, inflammatory bowel disease, pseudomembranous colitis, small and large bowel obstruction, bowel related vasculitis, and is particularly helpful for detecting tumors, such as gastric carcinoma, primary bowel lymphoma, and colorectal cancer. Familiarity with sonographic appearances of the above mentioned diseases affecting intestine allows specific diagnosis based on the degree and distribution of bowel wall thickening and associated changes of the surrounding tissues.[3] The purpose of this article was to demonstrate the sonographic features of gut masses detected either incidentally or purposely through the gastrointestinal tract with histological correlation for the confirmation of sonographic diagnosis and to compare the sonographic appearance of different abnormalities of the gut masses to evaluate the role of sonography in their differential diagnosis.

Methods

This cross sectional study was conducted in

Department of Radiology in collaboration with Department of Pathology between September 2009 and February 2013. Ultrasound scanning was performed in the patients with abdominal pain or vague symptoms related to the gastrointestinal tract, referred from the indoors & Out Patient Department of Services Hospital Lahore, with clinical suspicion of underlying primary gastrointestinal pathology. The patients' medical records were reviewed. The study population consisted of 72patients,including 45 men and 27 women, who were 20-75 years old (mean, 46 years old). The diagnosis was confirmed either by histology through surgically ressected specimen, trucut biopsy, flexible endoscopic biopsy or fine needle aspiration.

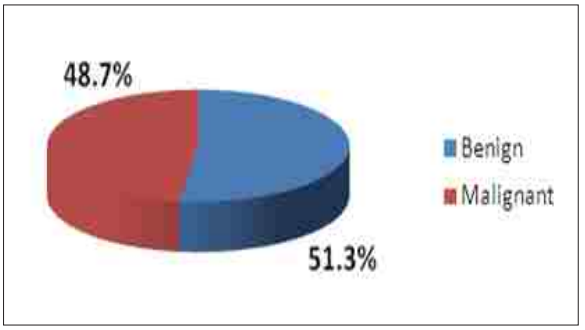

Fig-1: Gut masses percentage distribution according to the benign and malignant histologic features.

Ultrasound Technique and applied parameters:

We performed transabdominalsonography using Toshiba Xario (SSA 660A; Tokyo, Japan). Sonographic scans of the abdomen were usually performed after the clinical examination. The selection of transducer was based on the patient's built; 3.5 MHz curvilinear transducer was used for heavy patients. A high-frequency linear array transducer was used for superficial abnormalities. The large intestine was examined by starting in the right upper quadrant with identification of the ascending colon, recognized by its constancy of position and the presence of haustra, proceeded along the ascending colon to the right lower quadrant, where the cecum was identified as a blind-ending loop of large intestine. The terminal ileum was then identified, and the region of the appendix was examined. Once the right lower quadrant had been adequately assessed, the ascending portion of the colon was followed along the transverse and descending portions of the colon. The sigmoid colon was followed into the pelvis, and the rectum was visualized through the distended urinary bladder. The potential location of small bowel loops was then scanned. Small bowel loops were recognized by the presence of valvulaeconniventes when the lumen was filled with fluid. During ultrasound examination, repositioning of the patient and compression was often performed to optimally visualize the region of interest. Color Doppler was applied to assess flow in the abnormally detected part of gut. The perienteric soft tissues were assessed for the presence of enlarged lymph nodes and for inflammation or infiltration of the perienteric fat by the gut masses.

Normal intestine has a layered appearance and is compressible. It shows intermittent peristalsis. The normal large intestine has a wall thickness of 4 mm or less, whereas the small intestine has a thinner wall 1. The abnormal intestine demonstrated one or more of the following features: increased thickness (>4 mm), loss of the layered appearance, and lack of compressibility 2. Assessment of the degree and distribution of wall thickening was important in determining the underlying cause. When a focal mass was noted, its location relative to the bowel wall was determined and classified in one of the following categories: intraluminal, mural, or exophytic. The perienteric fat, when either inflamed or infiltrated, became hyperechoic and produced a mass effect. Enlarged mesenteric lymph nodes were found more in association with infectious or inflammatory than neoplastic processes.

Table-3: Relationship of GMFCS levels with classification of cerebral palsy and topographical classification of cerebral palsy.

Sonographic detected pathology	No. of Patients (n=72)		
	Male	Female	Total
Distal esophgeal cancers	2	0	2 (2.7%)
Gastric cancers	5	2	7 (9.7%)
Small bowel lymphoma	4	5	9 (12.5%)
Jejunail / Ileoceacal masses	8	6	14 (19.4%)
Intussusception	2	4	6 (8.3%)
Acute appendicitis / appendicular masses	12	6	18 (25%)
Diverticulitis	1	0	1 (2.0%)
Colorectal cancers	11	4	15 (20.8%)

Results

Out of 72 patients, there were 9 patients with upper GI tract masses including 2 cases of distal end esophageal cancer and 7cases of gastric cancer. Small bowel masses included 9 cases of primary small

bowel lymphoma. Intussusception was found in 6 patients. Ileoceacal masses were found in 13 patients with one case of jejunal mass. 18 patients were diagnosed as acute appendicitis out of which 3 patients Demonstrated appendicular mass. Large intestine revealed a single case with diverticulitis besides 15 cases of colorectal cancer detected sonographically. The small and large masses with either bulky lobulations or segmental wall thickening possessed an echogenic center due to air and bowel contents in the lumen or ulcer simulating appearance of kidney demonstrated as "Pseudokidney sign". The diffused wall thickening in uniform pattern with an echogenic center demonstrated "Target sign". The central echogenic clusters were rather small because of narrow lumen. Esophageal tumors involving distal esophageal end, which is intrabdominal part, appeared hypoechoic eccentric or circumferential mural thickening. Esophageal distension proximal to an obstructing tumor was also demonstrated. On histological correlation, 1 out of the 2 cases turned out to be adenocarcinoma of esophagus, while the other was diagnosed as squamous call carcinoma histologically.

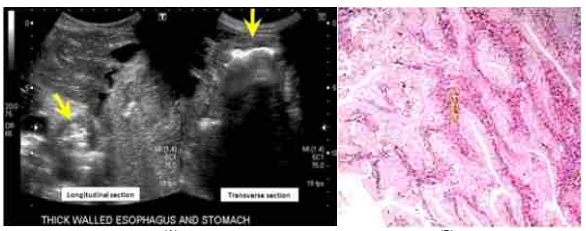

Fig-2: (a)Distal esophageal tumors with hypoechoic eccentric lumen and circumferential mural thickening (longitudinal sonogram) and extension of the tumor in the stomach (transverse sonogram). (b) Histology: Stratified squamous epithelium with underlying stroma glandular structures lined by pleomorphic, hyperchromatic cells consistent with well differentiated adenocarcinoma.

Seven patients with gastric cancer were diagnosed who presented for ultrasound examination due to nonspecific upper abdominal symptoms. Gastric cancer produced a localized or diffuse hypoechoic mass with destruction of the normal layered appearance of the bowel wall. The histological correlation revealed 2 out of 9 cases were of primary stomach lymphoma while all the other cases were adenocarcinoma of the stomach.

We detected 6 cases of intussception, all 6 patients belong to adult age group. 4 cases were ileocolic while 2 wereileoileal intussusceptions confirmed on histological specimen after surgical resection. Ultrasound is the modality which is close to 100% sensitive in detecting intussusceptions. The small bowel mass revealed "doughnut / target / bulls eye sign" on transverse scan with concentric rings of alternating hypoechoic and hyperechoic layers (intussuscipiens) with central hyperechoic portion (mesentery of intussusceptum).

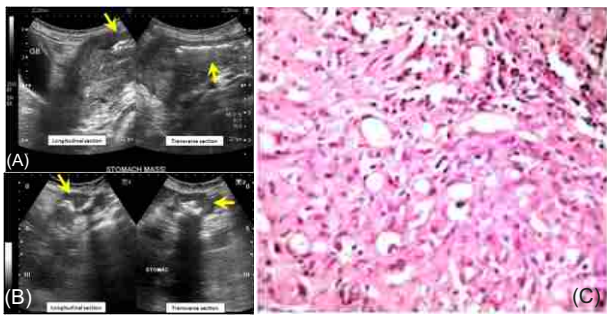

Fig-3: (a & b) Gastric cancer withlocalized/diffuse hypoechoic mass, destruction of the normal layered appearance of the bowel wall (yellow arrows) and an echogenic center due to air. (c) Histology: Poorly differentiated adenocarcinoma of signet ring type.

"Pseudokidney/sandwich/hay fork sign" was demonstrated on longitudinal scan as hypoechoic layers on each side of echogenic center of mesenteric fat peritoneal fluid trapped inside intussusception associated with irreducibility and ischemia. Color Doppler demonstrated mesenteric vessels dragged between entering + returning wall of intussusceptum with absence of blood flow suggested bowel necrosis in two cases. However, flow was demonstrated in one case within intussusceptum considering it a good predictor of reducibility.

Table-2: Gut masses percentage distribution according to the benign and malignant histologic features.

No. of sonographically detected gut masses (N=72)

Histology of Gut Masses

Benign: 37(51.3%) Malignant: 35 (48.7%)

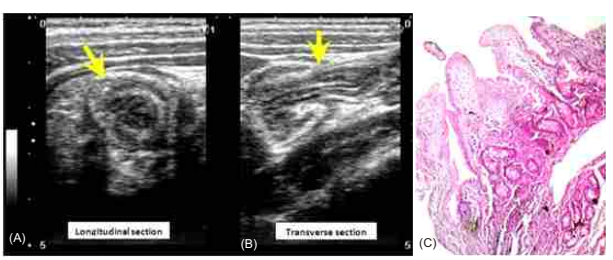

Fig.4: (a) Small bowel mass revealed "doughnut / target / bulls eye sign" with concentric rings of alternating hypoechoic and hyperechoic layers (intussuscipiens) and central hyperechoic portion (mesentery of intussusceptum). "Sandwich sign" was also demonstrated as hypoechoic layers on each side of echogenic center of mesenteric fat. (b) Histology: Small bowel mucosa with normal villous architecture. No dysplasia or malignancy seen.

While through the journey of intestine, we came across a mass at the junction of distal duodenum and proximal jejunum. The mass revealed segmental bowel wall thickening possessing an echogenic center due to air. The appearance was more in keeping with primary small bowel neoplasm, either leiomyoma or lymphoma. Upon histological correlation, it turned out to be a case of intestinal tuberculosis.We found two more cases of ileocecalmass that turned out to be intestinal tuberculosis on histology rather than primary ceacal cancer. Narrowedterminal ileum with thickened ileocecaljunction was demonstrated.

Table-3: Regional distribution of gut masses along with their histology.

Region of the gast-rointestinal Tract	Sonographic Diagnosis	Histological Corelation
Distal esophagus	Esophageal cancers (n=2)	Adenocarcinoma (n=1) sequamous cell carcinoma (n=1)
Stomach	Gastric cancers (n=7)	Adenocarcinoma (n=5) Primary lymphoma (n=2)
Small intestine	Lymphoma (n=9) Jejunal /ileocealcal masses (n=14)	B-cell lymphoma (n=9) jejunal tuberculosis (n=1) Ceacaladenocarcimona (n=2) Intussusception (n=6)
Large intestine	Appendicitis (n=18) Diverticulosis (n=1) cancers (n=15)	Acute appendicitis (n=15) Complicated appendicitis (n=3) Diverticulitis (n=1) Adenocarcinoma (n=13) Mucinous carcinoma (n=2)

Acute appendicitis was diagnosed in 18 patients on sonographic as well as histological appearances. The sonographic diagnosis was established when a distended (diameter >6 mm), non-compressible aperistaltic appendix was identified. Appendicoliths were present in 2 cases and were seen as echogenic, shadow producing structures within the lumen of the appendix.[4] In acute appendicitis with appendicular mass, the peri-appendiceal fat and mesentary became inflamed and echogenic. When compression was applied, the appendix and the inflamed fat moved as a relatively fixed structure. Color Doppler was useful in demonstrating a hyperemic wall.[5]

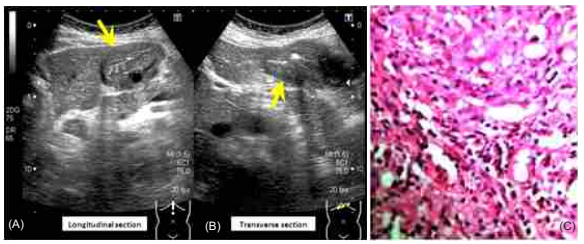

Fig-5: (a) Bulky pylorictumors adjacent to the left lobe of liverwith segmental wall thickening possessing an echogenic center due to air in the lumen simulating appearance of kidney demonstrated as "Pseudokidney sign".(b) Histology: Poorly differentiated adenocarcinoma of signet ring type.

Diverticulitis was present in one case. Diverticulum was seen as outpouching from the bowel wall and was found in the sigmoid colon. Muscular hypertrophy, inflammation, and edema produced segmental hypoechoic bowel wall thickening.[6]

We found 9 cases of primary gut lymphoma diagnosed on abdominal ultrasound. Most gastrointestinal lymphomas were B-cell tumors on histological correlation and involved the small intestine more commonly than the large intestine.[7] At sonogram, these tumors appearedhypoechoic and showed a variety of growth patterns including circumferential wall thickening as well as nodular or bulky tumor spread. Circumferential involvement was the most common pattern demonstrated.[8] The affected lumen showed aneurysmal dilatation, which is thought to be a result of destruction of the autonomic nerve plexus by the tumor. Lymphadenopathy in the adjacent perienteric structures was also demonstrated.

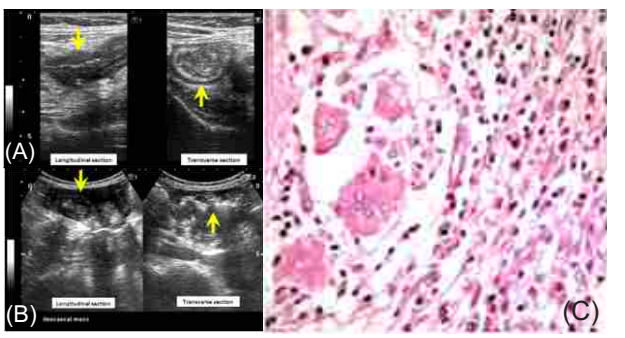

Fig.6: (a) Mass at the junction of distal duodenum

and proximal jejunum revealed segmental wall thickening possessing an echogenic center, appearance more in keeping with primary small bowel neoplasm(leiomyoma or lymphoma). Histologically it turned out to be jejunal tuberculosis. (b). Ileoceacally it turned out to be jejunal tuberculosis. (b). Ileoceacal mass with diffused wall thickening in uniform pattern demonstrating "Target sign". (c) Histology: Poorly formed granulomas with an abscess on the serosal wall of the small bowel suggestive of chronic granulomatous inflammation (intestinal tuberculosis).

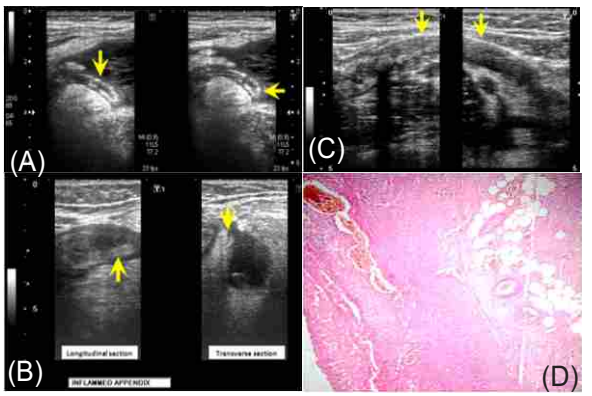

Fig.7: (a) Acutely inflamed appendixdemonstrated as a distended (diameter >6 mm), non-compressible aperistalticstructure. (b). Appendicular mass with thickening of peri-appendiceal fat and mesentary. (c).Acutely inflamed diverticulum with blind ending aperistaltic lumen.(d) Histology: Appendix with ulcerated mucosa with lumen containing inflammatory exudates, submucosa and serosa infiltrated by dense mixture of acute and chronic inflammatory cells, consistent with acute suppurative appendicitis (a) with localized peritonitis (b).

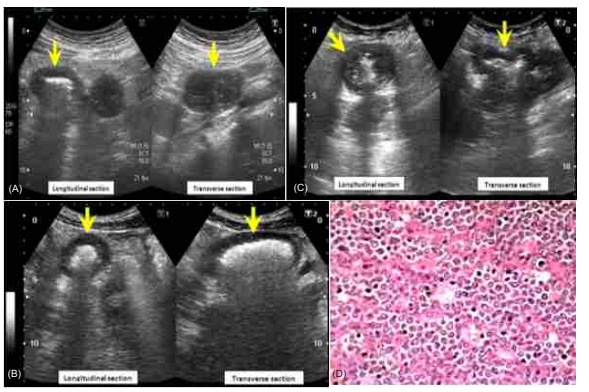

Fig-8: (a, b, c) Small and large masses with bulky lobulations and segmental wall thickening (Pseudokidney sign).(d) Histology: Diffused sheets of neoplatic lymphoid cells, consistent with high grade Non-Hodgkin's lymphoma.

There were 15 cases of colorectal cancers detected on transpelvicsonography. Adenocarcinoma was the most common malignant tumor of the colon on histology, however, 2 cases of mucinous carcinoma were also found. Morphologically, the tumor produced either an annular or polypoid colonic mass. Sonogram revealed an annular tumor that appeared as a hypoechoicmass with central linear echoes, representing the tumor and air in the residual lumen, respectively. Polypoid tumors appeared as focal, irregular colonic wall thickening. An abrupt lossof the normal layered appearance of the bowel wall was typical of a neoplastic process.

Discussion

By virtue of its lack of radiation, noninvasiveness, recent technical advances and cost-effectiveness, sonography is frequently the first examination performed in the evaluation of patients with abdominal complaints and may allow the detection of unexpected tumor within the abdominal cavity.

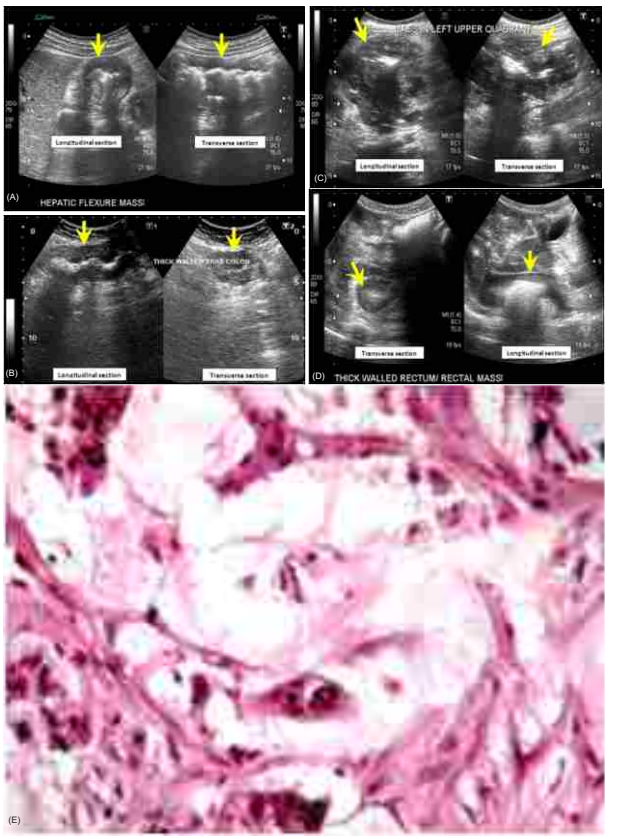

Fig-9: Large bowel including hepatic flexure (a), transverse colon (b), splenic flexure (c) and rectum (d)

revealing variable sized masses with segmental wall thickening, an echogenic center due to air trapping and bowel contents in the lumen is also seen, diffused but uniform bowel wall thickening with an echogenic center (Target sign). (e) Histology: Fragments of tissue infiltrated by malignant epithelial neoplasm composed of glands and sheets of pleomorphic malignant epithelial cells with hyperchromatic vesicular nuclei and prominent nucleoli, suggestive of moderately differentiated adenocarcinoma.

Easiness of sonographic detection of bowel pathology, purposely or unexpectedly, warrants the inclusion of bowel loops during ultrasound examination when a patient complains of symptoms indicating diseases of the bowel. Sonography has become a major diagnostic tool by directly imaging the gut and detecting any perienteric changes. Weundertook this study to systematically assessthe sonographic appearance of different gut related abnormalities to evaluate the role of sonography in their differential diagnosis.[9]

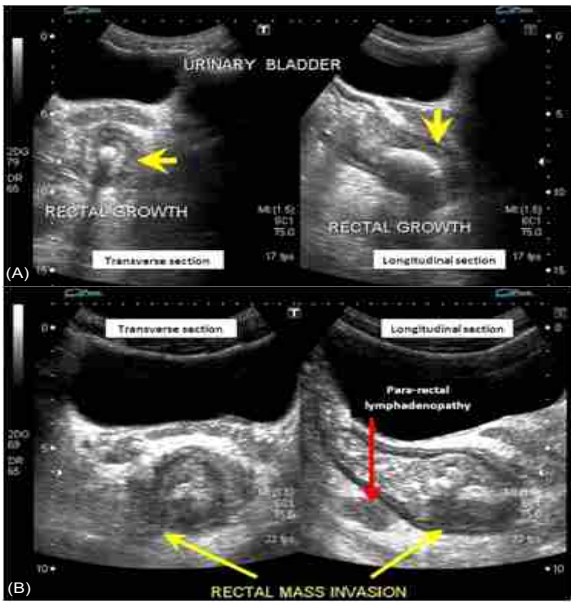

Fig-10: (a) Rectal mass with segmental wall thickening and an echogenic center. (b). Rectal mass with para-rectal invasion and lymphadenopathy suggestive of advanced stage of the disease.

The distribution of gut involvement varied among the diseases examined. Involvement of the left hemicolon in diverticulitis was found in one patient. As expected, a short diseased segment was a significant finding favoring malignant rather than benign conditions. Circumferential involvement was seen in most of the study population. Loss of stratification was found to be significantly more common in malignant conditions than in the benign entities. As shown in previous cross-sectional imaging reports,[10] asymmetric involvement aided in the differentiation of malignant from benign conditions. The association of diverticula with diverticulitis is highly significant. Therefore, diverticula shouldbe sought when evidence suggests segmental thickening of the colon. Not surprisingly, we found almost half of the gut mass related to the large intestine (47%) including appendicular masses, diverticulitis and colorectal cancer. Out of all gut masses we detected sonographically, half of the cases turned out benign histologically (acute appendicitis and complicated appendicitis, diverticulitis, jejunal and ileoceacal tuberculosis and intussusceptions respectively). Adenocarcinoma was the most common malignant tumor involving all gastrointestinal tract except small bowel, in lymphoma was predominant malignancy.

Conclusion

In our experience, ultrasonography of the gastrointestinal tract is extremely useful for evaluation of gut masses from distal esophagus up to rectum. Patients complaining of dysphagia, acute abdominal or nonspecific gastrointestinal symptoms and signs such as abdominal pain, diarrhea, hematochezia, change of bowel habit, or bowel obstruction, should undergo abdominal sonography to reveal the primary causes. Sonographic appearance of gut related masses is often of certain help to evaluate the clinical differential diagnosis. However, in patients with gut mass or bowel wall thickening detected on ultrasonography, additional work-up may be needed in the form of contrast study, cross-sectional imaging or endoscopy for reaching a specific diagnosis followed by histological confirmation.

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