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Acute Abdomen: Role of Ultrasonography in Differentiation of Common Clinical Mimics of Appendicitis

Dr.Swarnava Tarafdar Senior Resident, Department of Radiodiagnosis, Shri Mahant Indiresh Hospital, Patel Nagar , Dehradun-248001

Dr. Ankur Malhotra Assistant Professor, Department of Radiodiagnosis, Shri Mahant Indiresh Hospital, Patel Nagar , Dehradun-248001

Dr. A.T. Tayade Professor, Department of Radiodiagnosis, Shri Mahant Indiresh Hospital, Patel Nagar , Dehradun-248001

ABSTRACT

This is a prospective study conducted on 425 patients of 11 to 30 years age group with clinically suspected appendicitis. All the patients were evaluated on ultrasonography (USG). Out of 425 patients, in 136 cases (32% patients), the ultrasound (US) diagnosis was other than appendicitis like mesenteric adenitis, ileitis and colitis, right ureteric stone and ovarian cyst etc. in whom the appendix was normal. Thus, Clinical diagnosis based on symptomatology alone is not sufficient to make or confirm the diagnosis of the appendicitis, thus necessitating the need to be subjected for USG for the confirmation of the diagnosis.

KEYWORDS : Appendicitis, differential diagnosis, colitis, tuberculosis, Ultrasonography

INTRODUCTION:

Although most acute abdomen in emergency department (ED) are benign, however as many as 10 percent of patients in the ED and a lesser percentage in the outpatient setting have a severe or life-threatening cause of abdominal pain which require immediate attention (e.g., appendicitis, cholecystitis).[1] Therefore, a thorough and logical approach to the diagnosis of acute abdomen is necessary to initiate rapid and adequate treatment. Common clinical mimics of appendicitis are mesenteric adenitis, ureteric colic , salpingitis, ruptured ovarian follicle, torsion or ruptured ovarian cyst, tubo-ovarian abscesses, endometriosis, pyelonephritis, urinary tract infection, acute cholecystitis ,inflammatory bowel disease, uterine fibroids.[2, 3,4]

Less commonly conditions like pancreatitis, enterocolitis, obstruction, meckel's diverticulitis and rectus sheath haematoma may also be confused clinically with appendicitis. Most of these conditions can be readily and accurately diagnosed on ultrasonography in expert hands. A clinician decision to operate in these cases for appendicitis can lead to the removal of a normal appendix in approximately 15–30% of cases.[5] So, immediate surgery without appendicitis also adds up to surgical costs and potential complications. On the other hand observation of patient without appendicitis can prolong hospital stay and unnecessary use of hospital resources. Thus, for diagnosing appendicitis a reliable modality is required which should be accurate, cost effective, rapid and noninvasive.[6] Ultrasound fulfils all these requirements satisfactorily.

MATERIALS AND METHODS:

This prospective study was carried out in the Department of Radiodiagnosis, M.G.I.M.S., Sevagram, Maharashtra. This study includes sonographic evaluation of 425 patients with clinically suspected appendicitis in 11-30 years age group of both sexes from 2011 to 2014. Approval for the study was obtained by institutional ethical committee. The study was done in PHILIPS HD11 XE 3D/4D Color Doppler USG machine .A written informed consent was obtained of each patient, for those younger than 18 years, consent was taken from their parents. Women with ectopic pregnancy were excluded from this study.

Technique

Examination of the intestine was performed after the standard examination of the solid abdominal organs. The choice of transducer was based on the patient's body habitus: A 3-MHz curvilinear transducer was used for heavy patients, whereas a 5 or 7 MHz transducer was used for average or thin patients. A high-frequency linear array transducer was used for superficial abnormalities while a transvaginal transducer was used for deep pelvic disease in women. [7,8,9]

Entire large intestine was systematically examined by starting in the right upper quadrant with identification of the ascending colon first, recognized by its haustral markings. The transducer was then sweeped 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. The ascending colon was followed cranially and transverse and descending portions of the colon were examined. [7,8,9] The sigmoid colon was followed into the pelvis and the rectum was visualized through the distended urinary bladder.

Small bowel loops were recognized by the presence of valvulae conniventes in the distended state. Graded compression technique with the transducer was performed to displace the bowel loops and to optimally visualize the region of interest. [8,9] Color Doppler US was used wherever necessary to assess inflammatory disease and to support the suspicion of a tumor. The perienteric soft tissues were assessed for the presence of enlarged lymph nodes and for inflammation or infiltration of the perienteric fat.

Normal appendix

It is a blind-ended, tubular, compressible intestinal loop which is continuous with the cecum and has a diameter of less than 6 mm.

Acute appendicitis

Appendix that are incompressible, aperistaltic and larger than 6 mm in short-axis diameter are classified in this group.[7,10] Appendicoliths seen as echogenic, shadow-producing structures may be present within the lumen of the appendix.[11]In acute appendicitis, the periappendiceal fat becomes inflamed and echogenic. In equivocal cases, the use of color Doppler US is useful in demonstrating a hyperemic wall when appendicitis is present.[12] Tenderness with compression of the transducer is also a helpful secondary finding in diagnosing appendicitis when the gray-scale features are equivocal.[13]In case of discontinuity in the wall , asymmetry of wall thickness, presence of air or fluid collection with echoes around appendix, perforated appendicitis is diagnosed. Gangrenous appendicitis is diagnosed when there is focal loss of echogenic submucosal layer of the appendiceal wall with surrounding echogenic fat. Appendicular lump is formed when there is a large mass of non compressible echogenic fat seen around appendix forming a mass. Appendicular abscess is suspected in case of localized fluid collection which is walled off by adjacent greater omentum and small-bowel loops. Thus when a complex, hypo echoic mass adjacent to cecum or appendix is identified, even though

the inflamed appendix is not visualized, appendicular abscess is diagnosed. Color Doppler study shows increased peripheral vascularity in such cases.

Mesenteric Lymphadenitis

Mesentenic lymphadenitis is one of the most common causes of acute abdominal pain in patients especially in 11 to 30 years age group. Gray-scale US shows multiple, enlarged, hypoechoic mesenteric lymph nodes with or without mild thickening of the bowel wall.[14] Lymph node enlargement can be found in approximately 40% of cases of appendicitis, but generally the nodes are not as numerous non as large as those visualized in patients with mesenteric lymphadenitis. The absence of a hyperemic blind-ending tubular structure in the right lower quadrant also suggests the diagnosis of mesenteric lymphadenitis rather than appendicitis.

Colitis

Abnormalities that cause diffuse bowel wall thickening includes inflammatory bowel disease and ileocecitis. Color Doppler shows mural hyperanemia . Diffuse thickening of the bowel wall creates a characteristic appearance, referred to a target pattern, when imaged in a transverse plane.[15] The most frequent gastrointestinal disease is viral gastroenteritis which typically produces dilated, hyperperistaltic, fluid-filled small bowel loops.[16]

Renal diseases

Renal diseases that occasionally cause pain mimicking appendicitis are right-sided hydronephrosis and acute pyelonephritis.[17] Severe pyelonephritis can produce diffusely enlarged echogenic kidney with loss of corticomeduliary definition on gray-scale images. Occasionally, acute renal infection results in a focal mass, called "lobar nephronia," or acute focal bacterial nephritis. Typically, lobar nephronia is a hypoechoic mass, rarely it is echogenic because of hemorrhage. Color Doppler US usually reveals decreased flow in these cases due to increased vascular impedance. Cystitis is defined as inflammation of the urinary bladder which is more common in women because of the short length of the urethra. On USG, the bladder wall is considered thickened if it is >3 mm in distended state and >5 mm in nondistended state.[18,19,20,21,22]

Ovarian Cysts

Ovarian cysts may be of follicular or corpus luteal origin and may produce pain secondary to pressure on adjacent structures, hemorrhage or torsion. Classically, simple cysts appear as thin-walled and anechoic lesions.[23]On gray-scale US, hemorrhagic cysts usually are complex masses with internal echoes, septations or fluid-debris levels. In these cases, color Doppler images usually demonstrate absent central blood flow with peripheral blood flow in the surrounding ovarian parenchyma.

In case of ovarian torsion, US features includes enlarged hypo- or hyperechoic ovary, peripherally displaced follicles with hyperechoic central stroma, midline ovary, free pelvic fluid (which is seen in >80% of cases), an underlying ovarian lesion (possible lead point for torsion). The long-standing infarcted ovary may have a more complex appearance with cystic or haemorrhagic degeneration. Color Doppler **features** include little or no intra-ovarian venous flow which is a common finding, absent arterial flow which is less commonly seen but a poor prognostic sign and absent or reversed diastolic flow. [24] However, normal vascularity does not exclude intermittent torsion. Normal Doppler flow can also occasionally be found due to dual supply from both the ovarian and uterine arteries. Whirlpool sign of twisted vascular pedicle may also be seen.[24]Also, the ovary is tender to transducer pressure.[25]

Abdominal tuberculosis

The US findings commonly includes voluminous fluid collection with serosal thickening with multiple peritoneal and omental nodular lesions.[26] Omental thickening with echogenic and thickened mesentry is seen.The small bowel loops are matted and dilated secondary to multiple strictures. There can be thickening of ileocaecal valve, narrowing of terminal ileum with mural thickening of ileum and caecum with increased submucosal vascularity.[26] Multiple mesenteric, aortoiliac, retrocrural and periceliac adenopathies may be present. [27] The lymph nodes can show calcifications with presence of caseation. There can be conglomerated mass of lymph nodes in periportal and peripancreatic causing obstructive jaundice. Mild splenomegaly , complex ascitis with loculation and spetations can be present. In dessimated koch's multiple hypoechoic nodules are seen in liver.

Acute cholecystitis

Traditionally, the diagnosis of acute cholecystitis has been based on the clinical triad of right upper quadrant tenderness, fever and leucocytosis which is found to be present in only 8% of the patients. [28]

US is the most frequently performed and reliable modality for right upper quadrant pain and yields a sensitivity of 88% and a specificity of 80% in the diagnosis of acute cholecystitis.[29] Features of cholecystitis include gallbladder wall thickening, enlarged tender, noncompressible gallbladder and adjacent infiltration or fluid collections . According to ACR appropriateness criteria, US is considered the most appropriate imaging modality and should be considered as primary imaging modality for patients suspected of having acute calculous cholecystitis .[30]

Pancreatitis

On USG, pancreas is enlarged and shows reduction in echogenicity due to edema. However, echogenicity can be increased in cases of hemorrhage, necrosis and fat saponification. [31] Ascitic fluid is present in subhepatic space, right anterior pararenal and perirenal spaces. Associated extrapancreatic abnormalities such as gall stone detection and bile duct dilatation and obstruction can be present. [31]

Meckel's Diverticulitis

Meckel diverticulitis is the inflammation of Meckel diverticulum, which is the most common congenital structural abnormality of the gastrointestinal tract.[32]Despite this, it is an uncommon causes of acute abdomen, and is often not correctly diagnosed pre-operatively, thus necessiting the need for imaging modalities. On ultrasound, the meckel diverticulitis is usually seen as tubular incompressible blind ending hypoechoic structure with irregular margins in the antimesenteric border of the ileum.[33] Doppler may reveal anomalous vessels and signs of inflammation along the diverticulum.

RESULTS

The present study was prospective study carried out in the Department of Radiodiagnosis of our institute from 2011 to 2014. A total number of 425 patients in age group of 11 to 30 years referred from clinical departments with clinically suspected appendicitis were evaluated on USG as appendicitis is most common surgical emergency in this age group.[34] Out of 425 cases, in 136 cases the US diagnosis was other than appendicitis like mesenteric adenitis, ileitis and colitis, right ureteric stone, ovarian cyst etc. In rest 289 cases, 175 cases showed US features positive for appendicitis and in rest 114 cases the USG was normal. Distribution of 136 cases with diagnosis other than appendicitis on USG (differential diagnosis of clinically suspected appendicitis) is depicted in Table 1and Figure 5.The most common differential diagnosis of clinically suspected cases of appendicitis are depicted in figures 1 to 4.

Table 1. Distribution of cases with diagnosis other than appendicitis on USG

S No.	US findings	Methods used for confirmation	No. of cases	%
1	Mesenteric adenitis	Relief of pain and normal USG after few weeks follow up scan	46	34%
2	Ileitis/Colitis	Computed tomography(CT) with intravenous contrast material, stool examination and coloscopy/ biopsy	21	15%
3	Right ureteric stone	Hematuria, calculus excretion or migration on follow up	19	14%
4	Ovarian cysts	Relief of pain and normal US scan after treatment	18	13%
5	Abdominal TB	Contrast Enhanced CT (CECT)	5	4%
6	Acute cholecystitis	Surgery and histopathology	5	4%

7	Right pyelonephritis	Microscopic urine examination, relief of symptoms after treatment	5	4%
8	Pancreatitis	Confirmation by biochemical parameters and CECT	4	3%
9	Gastritis/ duodenitis	Endoscopy	4	3%
10	Meckel's diverticulitis	CECT	3	2%
11	Right renal stone	Non enhanced CT	3	2%
12	Cystitis	Microscopic urine examination, relief of symptoms after treatment and normal USG on follow up.	3	2%
	Total		136	100%

Figure 1. Mesenteric lymphadenopathy

Figure 2. Colitis

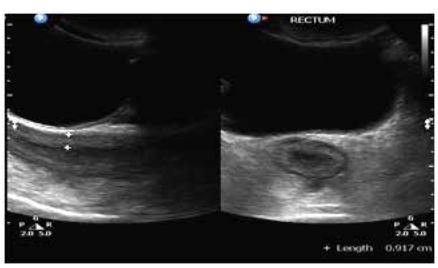


Figure 3. Right ureteric calculus

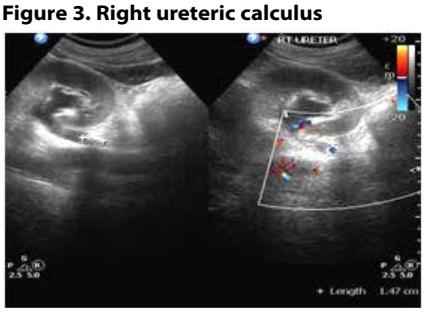
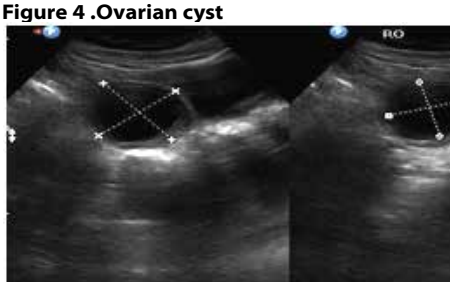


Figure 4 .Ovarian cyst



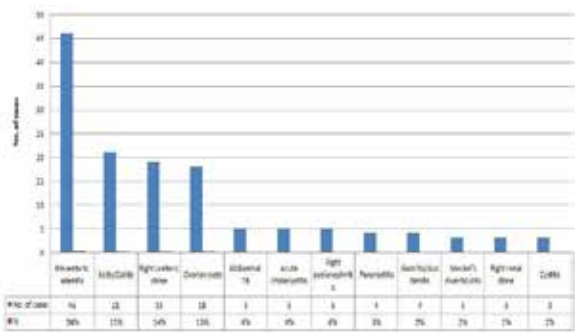


Figure 5. Bar graph depicting the distribution of cases

DISCUSSION

The preoperative diagnosis of appendicitis remains a major challenge for the clinicians, when done only on basis of clinical findings. The major reason for controversy being, the large overlap of clinical findings in various causes of right lower abdominal pain. USG has now become the first-step imaging technique for diagnosis appendicitis and also its various clinical mimics and is shown to be useful for selecting the appropriate treatment. It is a real-time dynamic examination which can be repeated again and again and it is also possible to correlate US findings with the point of maximal tenderness.[34]

In the present study 425 patients were evaluated prospectively on USG for appendicitis and 136 patients (32%) were found to have diagnosis other than appendicitis. The confirmation of the various differentials was done by various methods mentioned in Table 1. So, out of total 136 differentials included in our study, Mesenteric adenitis (34%) was the most common differential diagnosis in clinically suspected appendicitis cases in 11 to 30 years age group followed by ileitis and colitis (15%), right ureteric stone (14%) and ovarian cyst (13%). The less common conditions were abdominal tuberculosis (4%), acute cholecystitis (4%), right pyelonephritis (4%), pancreatitis (3%), gastritis and duodenitis (3%), meckel's diverticulitis(2%), right renal calculus (2%) and cystitis(2%).

The study is comparable to studies of Toorenvliet BR et al [35] (2010), Keyzer C et al[36] (2005) and Nautiyal N et al[37] (2010). In Toorenvliet BR et al[35] (2010) common differential diagnosis of clinically suspected appendicitis cases were mesenteric adenitis (31.7 %), ileitis and colitis (18.3 %), right ureteric stone (18.3%) and right pyelonephritis (6.7 %). The less common differential diagnosis were diverticular disease (5%), acute cholecystitis (3.3 %), pancreatitis (3.3%), gastritis and duodenitis (3.3%), perforation peritonitis (3.3%), meckel's diverticulitis (1.7%), right renal calculus (1.7%), epiploic appendagitis (1.7%) and cystitis (1.7 %).

Similarly in Keyzer C et al[36] (2005), the common diagnosis were colitis (19.4 %), ovarian cyst (16.6 %), right ureteric stone (11.1%), pelvic inflammatory disease (11.1%) and right pyelonephritis (8.3%) and in the study of Nautiyal N et al[37] (2010), the common differential diagnosis were acute mesenteric lymphadenopathy (26.6%), abdominal tuberculosis (26.6 %), terminal ileitis (13.3 %) and ovarian cyst (13.3%).

CONCLUSION:

The present study demonstrates that clinical evaluation based on symptomatology alone is not accurate enough to manage patients with suspected appendicitis, thus necessitating the need to be subjected for USG for confirmation of the diagnosis. In our study out of total 425 cases with clinically suspected appendicitis, 32% patients had diagnosis other than appendicitis. The top differentials were mesenteric adenitis, ileitis and colitis, right ureteric stone and ovarian cyst. Therefore, we strongly recommend use of US as a primary modality in the diagnosis of clinically suspected appendicitis cases especially when the clinical findings are indeterminate.

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