



STUDY OF PREOPERATIVE ULTRASONOGRAPHY OF ACUTE APPENDICITIS CORRELATION WITH HISTOPATHOLOGICAL EXAMINATION

KEYWORDS

Acute appendicitis, Ultrasonography, Histopathological Examination.

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ABSTRACT

Evaluation of diagnostic accuracy of preoperative ultrasonography in acute appendicitis and to correlate with histopathological examination.

INTRODUCTION :

Acute appendicitis is the most common cause of acute abdomen.¹ Although the clinical presentation of acute appendicitis is typical in 70% of the cases; about 30% of the patients have an uncertain pre-operative diagnosis. Consequently the rate of unnecessary laparotomy is as high as 20-25%. The rate is even higher (35-45%) in women of childbearing age, because of the female pelvic organs and complications of pregnancy in this group.²

The rate of perforation is increasing, with an average high of 23%, which is partially because of delayed surgery caused by uncertain diagnosis. Plain film diagnosis depending on the occasional demonstration of appendicolith or ureteric calculus is neither sensitive nor specific. The diagnosis of acute appendicitis by the barium enema studies is mainly based on the demonstration of non-filling of the appendix. It is not frequently used and it has an accuracy that ranges from 50-85%. White cell and anti-granulocyte scintigraphic scans have also been used in the diagnosis of right lower quadrant pain, but are expensive, time consuming and are not very sensitive. Computed tomography is considered to be sensitive and specific for the diagnosis of acute appendicitis. It is a relatively expensive test that often requires introduction of oral and intravenous contrast agents. Besides CT is neither sensitive nor specific for the diagnosis of gynecologic disease, a frequent mimicker of acute appendicitis. Ultrasound has also been shown to be highly sensitive and specific for the diagnosis of not only acute appendicitis but also other conditions that cause right lower quadrant pain.³

Till the development of high-resolution real time sonography it was not possible to evaluate acute appendicitis routinely. Recently with the availability of high frequency transducers, resolution is considerably improved enabling visualization and diagnosis of appendicular pathologies. In experienced hands, graded compression sonography is particularly useful in cases of suspected uncomplicated acute appendicitis. Obvious advantages of ultrasound are, 1) it does not employ any ionizing radiation, non-invasive 2) there is minimal discomfort to the patient, 3) its easy availability, portability, and repeatability 4) no specific patient preparation is required

In many centers, sonography has become the procedure of choice for the initial evaluation of acute appendicitis with equivocal clinical features, particularly in pediatric and women of childbearing age group.

Very few studies have been conducted in our part of the country and sufficient data was not available regarding the role of sonography in the evaluation of clinically suspected cases of appendicitis. We conducted this study titled "Sonological Evaluation of Acute Appendicitis" to establish the role of sonography either in diagnosis or in ruling out appendicitis as the cause of acute abdomen, thus enabling in avoiding unnecessary negative laparotomies.

PATHOGENESIS:⁴

Obstruction of the lumen is the dominant causal factor in acute appendicitis. Faecoliths are the usual cause of appendiceal obstruction. Less common causes are lymphoid tissues, inspissated barium from previous x-ray studies, vegetable and fruit seeds and intestinal worms, particularly ascariasis. The frequency of obstruction rises with the severity of the inflammatory process.

ULTRASONOGRAPHY

Ultrasonography is an established imaging method to confirm or rule out acute appendicitis in patients with right lower quadrant pain.

SONOGRAPHIC FINDINGS IN ACUTE APPENDICITIS:

- Non-compressible, blind-ending, aperistaltic tubular structure in right lower quadrant arising from the base of caecum.
- Target lesion" appearance of appendix.
- Appendiceal diameter greater than 6mm.
- Lumen distended with anechoic, hypoechoic material.
- Appendicolith.
- Circumferential loss of submucosal layer of appendix.
- Loculated and prominent pericaecal fluid.
- Prominent pericaecal fat.

MATERIALS AND METHODS

Type of study:

The present study is a non-randomized, prospective study. Fifty patients who reported to the surgical OPD or emergency Department Kurnool Medical College, Kurnool with history of abdominal pain in whom the clinical signs were equivocal for acute appendicitis were sent for ultrasound evaluation. After the sonographic examination, the results were compared with Histopathology results.

Study period

This study was performed during the period from Aug-2012 to Sept-2014 excluding the period of data analysis

and write-up.

Selection criteria:

Inclusion criteria:

- 1) Patients clinically suspected to be having acute appendicitis.
- 2) All individuals irrespective of age and sex.
- 3) Cases with history of recurrent appendicitis
- 4) Cases of acute appendicitis with early pregnancy were also included in this study.

Exclusion criteria:

- 1) All other causes of acute abdomen.
- 2) Cases with recurrent appendicitis not presenting with acute symptoms.
- 3) Cases of acute appendicitis diagnosed clinically and sonologically but not willing for further management were excluded from the study.

Sonological criteria for acute appendicitis:

- Eliciting sonographic McBurney's point tenderness
- Blind ending immobile, noncompressible tubular structure in the right iliac fossa
- Bull's eye or target lesion with diameter of >6.0mm
- Presence of appendicolith
- Complex appendiceal mass or abscess
- Other associated findings like integrity of the submucosal layer, periappendiceal fluid collection, pericaecal increased echogenicity, hypo/hyper peristaltic loops in the right iliac fossa, enlarged mesenteric lymphnodes.

Ultrasonological and Histopathological Correlation:

Preoperative clinical findings, ultrasonological findings of Acute appendicitis were correlated with that of Histopathological examination.

Age and Sex incidence:

Table - 1

Age incidence (Yrs)	Males	Females	Total No.of cases	Percentage
1-10	-	1	1	2%
11-20	7	5	12	24%
21-30	16	6	22	44%
31-40	3	3	6	12%
41-50	4	2	6	12%
51-60	-	2	2	4%
61-70	-	-	-	-
71-80	1	-	1	2%
Total	31	19	50	-

Age incidence: Varied between 1st to 8th decades of life. The peak incidence of 44% was found to be in the age group of 21-30 yrs. The mean age in the present study was 28.74 years with a standard deviation of 13.40 yrs. The youngest patient treated was 6 yrs old and oldest patient was 75 yrs old.

Sex incidence: Acute appendicitis affects males more frequently than females. In our study there was a male preponderance for acute appendicitis with M: F ratio of

1.63:1.

Chief complaints

All patients in our series presented with pain abdomen, 68% of patients presented with pain in the right lower quadrant of abdomen and 32% of patients presented with pain in both umbilical and right lower quadrant region.

Fever was an associated symptom in 78% of patients. Fever ranged from mild to moderate degree. Vomiting was another associated symptom in 36% of patients associated with anorexia in most of the cases. Burning micturition was present in 2% of our patients. Constipation was the most common bowel disturbances seen in 52% of our patients. Diarrhea was present in 2% of patients in our series. White discharge per vaginum was seen in one case.

General Physical Examination

In our study 78% of patients had an associated fever, the degree of febrileness ranging from mild to moderate degree. The pulse rate of less than 100/min was recorded in the majority of patients (82%). Where as in 18% of patients the pulse rate was greater than 100/min. Mild dehydration was present in 20% of our patients. 4% of patients had moderate degree dehydration. In our study none of the patients had severe dehydration.

Abdominal examination

Rebound tenderness at McBurney's point was the commonest finding in the abdominal examination. It was found in 46% of patients in our study. 38% of patients had only right iliac fossa tenderness. Generalized guarding and rigidity was present in 12% of patients.

Laboratory investigations

Table-5

	Mean	Standard deviation	Confidence interval
Total white cell count	10611	3592.23	10611+/- 995.714
Neutrophil leukocytosis	62.16	12.44	60.76+/-3.44

Table-5a

Urine	No. of cases	Percentage
Pyuria	1	2%
RBC's	-	-

Total white cell count was raised in 30 (60%) patients and was in normal range in 20 (40%) patients, with a mean of 10,611 and a standard deviation of 3592.23 and confidence interval of 10,611+/-995.714.

Neutrophil leukocytosis was present in 28 (56%) of our patients and was in normal range in 22 (44%) of the patients, with a mean of 62.16 and standard deviation of 12.44 and confidence interval of 62.16+/-3.44.

Ultrasonography of abdomen

In our study 35 cases were positive for acute appendicitis accounting 72% of total patients. Out of these 27 cases (75%) were uncomplicated acute appendicitis. Perforated acute appendicitis was diagnosed in 3 cases (8.33%). 4 cases (11.11%) were diagnosed as appendicular abscess. In 2 cases (5.55%) complex appendicular mass was diagnosed.

Ultrasonography in appendicitis**Table-7**

	No. of cases	Percentage
Positive for acute appendicitis	36	-
USG findings		
Sonographic McBurney's tenderness	30	86.11%
Non-compressible	27	77.77%
Appendiceal diameter >6mm	27	77.77%
Appendicular abscess	4	11.11%
Visualization of complex appendicular mass	2	5.55%
Appendicolith	2	5.55%
Other findings		
Hypoperistaltic loops	6	19.44%
Periappendiceal collection	2	5.55%

Ultrasound findings in perforated appendicitis:**Table-8****Total no of cases-3**

	No. of cases	Percentage
Loss of submucosal integrity	1	33.33%
Loculated fluid collection	2	66.66%
Prominent pericaecal fat	1	33.33%

Ultrasonography was negative for acute appendicitis in 14 of our cases. In 4 cases (8%) we could directly visualize normal appendix, which was compressible with a diameter of less than 6mm. In the remaining 10 cases (20%) appendix was not visualized. In 3 cases (6%) right renal calculus was detected.

Management**Operative findings in cases reported as normal study on ultrasound**

	No. of cases	Percentage
Retrocaecal appendix	2	40%
Pelvic appendix	2	40%
Post ileal	1	20%
Gaseous dilatation of caecum	2	40%
Obese patient		
Dense Omental adhesions covering the appendix	1	20%
	2	40%
Total	5	

Five cases were falsely diagnosed as normal appendix in our study, which later on proved as acute appendicitis. In two cases each appendix was retrocaecal and pelvic in position and in the remaining one it was in post-ileal in position. In two cases there was gaseous dilatation of caecum. In other two cases dense omentum was covering the inflamed appendix.

Out of 44 patients in whom appendicectomy was done, 38 (86.36%) cases had acute appendicitis on histopathological

examination. In 6 cases it was normal.

RESULTS

Of the fifty cases, which were recruited for the study purpose on which the initial sonographic examination was done, 44 (88%) cases underwent appendicectomy. Out of these 38 (86.36%) cases were proved to be acute appendicitis on histopathological examination, in the remaining 6 cases (13.63%) it was shown to be negative for acute appendicitis.

Among the fifty cases for which ultrasound was done, 33(66%) were shown to be positive for acute appendicitis, 5 cases were diagnosed as false-negatives and 5 cases were diagnosed as true-negatives.

By ultrasound examination we were able to give alternative diagnoses in 6 (12%) cases, thus explaining the symptoms of patients.

Normal appendix was visualized in 4 (8%) cases. In 10 (20%) cases appendix was not visualized. The 5 (10%) cases where the patients were managed conservatively and the one case where appendicectomy was not done were excluded for the analysis to estimate sensitivity, specificity and accuracy.

In this study it is observed that the sensitivity is 86.64%, specificity is 83.33%, predictive value of positive test is 97.05%, predictive value of negative test is 50% and overall accuracy of ultrasound scanning is 86.36% with reference to histopathological confirmation .

DISCUSSION

Age prevalence showed that less than 5% of patients in the age group of 1-10 years and 6% of patients above the age group of 50 years were affected. Males were more commonly affected than females, with a male: female ratio of 1.63:1.

Symptoms:

Pain abdomen remained the most common initial symptom noted in 100% of patients. It was in umbilical and right lower quadrant in 32%(16) of patients and localized to right lower quadrant in the remaining 68%(34) patients. No significant difference in duration of pain existed between acute appendicitis and other pathological conditions like renal/ureteric colic and gynecological disorders in the study.

Anorexia and vomiting was seen in 36%(18) of patients, fever was seen in 78%(39) of patients.

Signs:

Rebound tenderness at McBurney's point was the commonest sign noted in 46% (23) of patients.

Laboratory investigations:

Total white cell count was raised significantly in 60 %(30) our patients and was in normal range in 40% (20) patients.

Significant Neutrophil leukocytosis was present in 56% (28) of our patients and was in the normal range in 44% (22) of the patients.

Ultrasonography in the diagnosis of acute appendicitis:

In our study we could identify normal appendix in 4 cases accounting for 8% of the total number of cases. The normal appendix was compressible, less than 6mm in diam-

eter and ovoid in cross-section. In these cases we confidently excluded the diagnosis of acute appendicitis. This is in conformity with the study of Thomas rettenbacher et al⁵ (2001). In the remaining 10 cases ultrasound was unable to detect either normal or abnormal appendix. This was due to presence of guarding and rigidity, which hinders compression, non-visualisation of normal appendix per se, presence of localised ileus and obesity.

The overall accuracy of sonography in the diagnosis of acute appendicitis in our study was **86.36%**. In this study the observed sensitivity, specificity, predictive value of positive test and predictive value of negative test of ultrasound scanning with reference to histopathological confirmation was **86.64%, 83.33%, 97.05% and 50%** respectively.

In the prospective study of 50 patients clinically suspected as acute appendicitis the following were the significant observations.

- 1 Acute appendicitis was more common in the age group of 20-40 yrs, followed by the 11-20 age group.
- 2 In acute appendicitis male preponderance was established in our study.
- 3 Right lower quadrant pain, fever, vomiting and constipation were the chief complaints in patients with acute appendicitis.
- 4 Rebound tenderness at McBurney's point was the commonest physical finding on examination of the abdomen.
- 5 Total white cell count was significantly raised in 60% of our patients.
- 6 Significant neutrophil leukocytosis was present in 56% of our patients. White cell count and neutrophil leukocytosis are therefore a significant coordinator of acute appendicitis in patients with acute appendicitis. However, acute appendicitis cannot be excluded in patients in whom these parameters are normal.
- 7 Ultrasonography in the diagnosis of acute appendicitis.
 - Appendiceal diameter greater than 6mm was diagnostic of acute appendicitis. This finding was considered as a criterion in the diagnosis of acute appendicitis in our prospective study.
 - Visualization of appendicoliths, appendicular abscesses and complex mass were also considered in the diagnosis of acute appendicitis.
 - In cases of perforated appendicitis there were indirect signs of perforation.

8 Surgical findings in acute appendicitis

- The accuracy of peroperative diagnosis of acute appendicitis was 97.72% while the inaccuracy was 2.27%.
- Retrocaecal appendix was found in 62.22% of our cases, similar to what is quoted in the literature.
- 10% of cases falsely diagnosed as normal on ultrasound showed signs of acute appendicitis per-operatively.

Histopathological Findings :

- Histopathologically proven cases - 38→86.36%
- Normal Appendix found in 6 cases →13.63%

Sex incidence : In our study there was a male predominance for Acute Appendicitis with M : F ratio of 1.63 : 1, which is nearer to the literature mentioned value of M : F - 1.26 to 1.3 : 1^{63, 64}

Negative Appendicectomy rate is 13.63% in our study, which is nearer to the literature mentioned value of 15.3%^{64, 65}

Surgery followed by Histopathological examination was the ultimate proof of acute appendicitis.

CONCLUSION

- Pre operative diagnosis of acute appendicitis by Ultrasound examination is accurate by 97.2%; p=0.028 which is significant.
- Histopathological confirmation is 86.4% & Negative Appendicectomy rate is 13.63%
- The sensitivity is 86.64%, specificity is 83.33%, predictive value of positive
- This study aids in early and accurate diagnosis of acute appendicitis inexperienced hands, thereby enabling early surgical management.
- The use of ultrasound helps in the identification of other pathological conditions clinically mimicking acute appendicitis, thereby reducing negative laparotomy rates or in suggesting alternate management.
- The USG study-- is non-invasive, non-traumatic, cost-effective, readily available/portable, result oriented and beneficial to the patients.
- Histopathological examination is the ultimate proof of Acute Appendicitis.

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