

Ultrasonographic Evaluation in the Diagnosis of Acute Appendicitis with Histopathological Correlation

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Abstract

Ultrasonogram is a useful tool in providing valuable information for the diagnosis of acute appendicitis. Ultrasound could increase the diagnostic accuracy in those patients presented with unclear symptoms and signs of acute appendicitis. The aim of this study is to evaluate the effectiveness of U/S in the diagnosis of acute appendicitis. This cross sectional study was carried out in the department of Radiology & Imaging, Sir Salimullah Medical College, Dhaka during the period of January'2016 to December'2016. It included 40 patients suspected to have acute appendicitis. Ultrasound (U/S) was done for all these patients. There were (18) males represent (45%) and (22) females represent (55%). These patients are grouped according to gender, age, signs & symptoms, the result of U/S examination and histopathological result. Ultrasound was positive in (33) patients (82.5 %) and negative in (07) patients (17.5%). Four patients out of (07) had true negative results while (03) patients were false negative. Ultrasound sensitivity was (91.4 %) in diagnosing acute appendicitis, specificity was (80%), accuracy rate was (92.5%), positive predictive value (96.7%) and negative predictive value (57.1%). As abdominal ultrasound showed high validity parameters for the diagnosis of acute appendicitis, the study concluded that ultrasonogram is a useful diagnostic modality in preoperative evaluation of acute appendicitis and can be used for planning of appropriate management.

Keyword: Ultrasonographic Evaluation, Acute Appendicitis, Histopathological Correlation.

Introduction

Acute appendicitis is still one of the most common surgical abdominal emergencies. In 70% of patients with acute appendicitis, the diagnosis is made clinically based on

classic sign and symptoms. In the remaining 30% of patients with uncertain clinical finding radiological imaging is needed to establish the diagnosis.¹ In acute appendicitis, the preoperative diagnosis is wrong in 30% and despite the improvement in surgical techniques, the negative appendicectomy rate continues to be as high as 25%.² Even despite the uncertainty of diagnosis, appendicitis demands prompt treatment in order not to be neglected and misdiagnosed leading to progression of the disease with associated morbidity and mortality that may include the risk of perforation which happens in approximately one third of the cases.³ The newer techniques of ultrasonography (US) and computed tomography (CT) have shown great promise in evaluation of patients with suspected acute appendicitis.⁴ The advantages of ultrasound examination to diagnose appendicitis is well known; the study is quick, widely available in most cases, non-invasive, repeatable and has been known to be accurate. High resolution ultrasound enables visualization of the inflamed appendix and can assess a variety of relevant disease. Bed-side ultrasound in evaluation of patients with suspected appendicitis is used nowadays as preliminary test.⁵ One expert team has identified three criteria for diagnosis of appendicitis by ultrasound examination which include; tender non compressible appendix, no peristalsis of the appendix and the overall diameter of the appendicular lumen is greater than 6mm.⁶ Demonstration of appendicolith alone does not suggest acute appendicitis.⁷ Computed tomography (CT) had a good role in the diagnosis of acute appendicitis but ionizing radiation and the use of intravenous contrast made it a relatively invasive test.⁸ It is also not available in all centres. It should be emphasized that USG does not replace clinical diagnosis, but is a useful adjunct in the diagnosis of acute appendicitis. Studies have demonstrated the potential to achieve higher diagnostic accuracy with imaging techniques than may be achieved with clinical acumen alone.⁹

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Objectives of the study:

This study was designed to a) evaluate the validity of ultrasonography (USG) in the diagnosis of acute appendicitis. Specific objectives were to b) diagnose clinically suspected acute appendicitis based on ultrasonographic findings, c) compare the ultrasonological diagnosis with that of histopathological diagnosis and to find out d) the sensitivity, specificity, positive predictive value, negative predictive value and accuracy of transabdominal ultrasound in the diagnosis of acute appendicitis.

Materials and Methods

This cross sectional study was conducted in department of Radiology & Imaging, Sir Salimullah Medical College, Dhaka in collaboration with the department of Pathology of the same institute from January 2016 to December 2016. Patients attended at the General Surgery department with clinically suspected acute appendicitis referred to the Department of Radiology and Imaging, Sir Salimullah Medical College, Dhaka was included in the study. A total of 40 patients were included in this study after taking written informed consent, who could fulfill the selection criteria as defined below.

Inclusion criteria:

- Patients of both sexes and of all ages having clinical suspicion of acute appendicitis referred for USG examination.

Exclusion criteria:

- Patients unwilling to give consent.
- Patients who are unwilling or unfit for surgery.
- Non availability of biopsy report.
- Diagnosis of any disease other than acute appendicitis.

Transabdominal ultrasonography was performed by Logiq P5 GE healthcare ultrasound Machine. A linear array transducer ; 11L Linear Probe (5-13 MHz) and convex Probe 4C (1.4-5MHz) used in examination. Patients were followed up upto their final diagnosis by histopathology. Their ultrasonogram and histopathological diagnoses were compared to find out the the validity of USG in the diagnosis of acute appendicitis. Appropriate data were collected by using a preformed data sheet. All the relevant collected data were compiled on a master chart and statistical analyses were done by computer software SPSS-19.0. The results were presented as text, tables, figures, charts, diagrams and the validity test was done.

Results

The following observations and results were obtained in this study. Out of 40 patients, the commonest age group among the patients were 20-30 year which were 18 (45%) respondents. The mean age (±SD) was 27.1 (±9.5) years (Table 1). Here male to female ratio was 1:1.2 (Table 2). Pain in right iliac fossa was the most important presenting

symptoms and was present in all the patients of this study (Table 3). On examination, all of the patients were found tenderness in right iliac fossa (Table-IV).

Table 1: Distribution of patients by age (n=40)

Age in years	Frequency	Percentage	Mean
≤ 20	11	27.5	27.1 ± 9.5
20 – 30	18	45	
>30	11	27.5	
Total	40	100	

Table 2: Distribution of patients by gender (n=40)

Sex	Frequency	Percentage
Male	18	45
Female	22	55
Total	40	100

Table 3: Distribution of patients by clinical features (n=40)

Symptom	Frequency*	Percentage
Pain in right iliac fossa	40	100
Pain in peri-umbilical region	18	45
Nausea	13	32.5
Vomiting	22	55
Pyrexia	08	20

Table 4: Clinical signs of patients and their distribution (n=40)

Sign	Frequency*	Percentage
Tenderness in iliac fossa	40	100
Rebound tenderness	30	75
Rovsing sign	17	42.5
Pointing sign	22	55
Muscle guard	32	80

In acute inflammed appendix- Probe tenderness in right iliac fossa was present in all patients. Peristalsis and compressibility was absent in 33 cases (82.5%). Diameter was >6mm, Wall thickness >3mm and surrounding echogenic fat was present in 33 cases (82.5%) (Table- 5). 20 patients (50%) had collection around the inflammed appendix (Table- 6). 05 patients (12.5%) had appendicolith within the lumen of inflammed appendix (Table- 7).

Table 5: Different ultrasonographic findings of appendix in study subjects & their distribution (n=40)*

Variable	Present		Absent	
	f	(%)	f	(%)
Peristalsis	07	17.5	33	82.5
Compressibility	07	17.5	33	82.5
Probe tenderness in right iliac fossa	40	100	0	0
Diameter >6mm	33	82.5	07	17.5
Wall thickness >3mm	33	82.5	07	17.5
Echogenic fat	33	82.5	07	17.5

Table 6: Distribution of fluid collection around the inflamed appendix (n=40)

Peri-lesional Collection	Frequency	Percentage
Present	20	50
Absent	20	50
Total	40	100

In evaluation of acute appendicitis by USG 33 cases (82.5%) were diagnosed as acute appendicitis (Table-8). Similarly histopathological 35 (87.5%) patients were diagnosed as acute appendicitis, 5 (12.5%) patients were diagnosed lymphoid hyperplasia of appendix (Table-9). Comparison of USG diagnosis with that of Histopathological diagnosis are shown in (Table-10). Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of MRI in the diagnosis of different types of paediatric posterior fossa tumours are shown in Table-10.

Table 7: Frequency distribution of appendicolith on ultrasonogram (n=40)

Appendicolith	Frequency	Percentage
Present	35	87.5
Absent	05	12.5
Total	40	100

Table 8: Frequency distribution of patients by Ultrasonographic diagnosis (n=40)

USG Diagnosis	Frequency	Percentage
Acute appendicitis	33	82.5
Normal Study	07	17.5
Total	40	100

Table 9: Histopathological diagnosis of study subjects (n=40)

Histopathological diagnosis	Frequency	Percentage
Acute appendicitis	35	87.5
Lymphoid hyperplasia of appendix	05	12.5
Total	40	100

Table 10: Comparison of ultrasonographic diagnosis with that of histopathological diagnosis (n=40)

Ultrasonogram	Histopathology		Total
	Positive	Negative	
Positive	32 (TP)	1 (FP)	33
Negative	03 (FN)	4 (TN)	07
Total	35	5	40

**Photograph 1:** Acute appendicitis- Long-axis ultrasound image of a 26 years old Male patient shows - a thick-walled, dilated, non-compressible, blind-ending tubular structure in the right iliac fossa, diameter of it is about 8.5 mm and lumen filled with hypoechoic fluid, with surrounding hyperechoic fat.



Photograph 2: Long-axis & cross-sectional transabdominal ultrasound image of acute appendicitis of 44 yrs male shows- a thick-walled, dilated, non-compressible, blind-ending tubular structure in the right iliac fossa, diameter of it is about 8.3 mm and lumen filled with hypoechoic fluid.



Photograph 4: Long-axis & cross-sectional transabdominal ultrasound image of acute appendicitis of 15 yrs old male shows- a thick-walled, dilated, non-compressible, blind-ending tubular structure in the right iliac fossa, diameter of it is about 7.8 mm and lumen filled with hypoechoic fluid, with surrounding hyperechoic fat.



Photograph 3: Acute appendicitis in a 22 yrs old female- long axis & cross-sectional image of ultrasound shows a distended, fluid-filled appendix that measured 6.9 mm in diameter. Echogenic fecolith with posterior shadowing within a fluid-filled dilated appendix.

Discussion

In this study it was observed that most common age group among the patients were 20-30 year which were 18 (45%) respondents. Mean \pm SD of age of the patients was 27.1 ± 9.5 years. Adesunkanmi, 1993 observed 90% of the cases had the commonest age group of 10-30 years.¹⁰

The incidence of acute appendicitis is variable in both sexes. Male to female ratio in the present study was 1:1.2. A study was done by Barber et al., 1997 and according to his study male to female ratio was 2.2:1.2. It can be seen from the given statistics, that there are no set patterns for incidence of the disease in both sexes and it is highly variable.¹¹

Acute appendicitis has been found to presenting with typical symptoms. Pain was the most important presenting symptoms and was present in all the patients of this study. This similar observation might be explained by the study done by Sharma et al., 2007 who reported lower abdominal pain in all cases of appendicitis. In this study 13 (32.5) patients experienced nausea and 22 (55.0%) had vomiting, once or twice usually in the early part of disease.¹³ Barber et al., 1997 observed that 51-69% of patients with appendicitis vomit.¹¹

Regarding the tenderness in acute appendicitis right iliac fossa tenderness was found in all the patients of this study. Incidence of tenderness in this study compares well with other studies where tenderness could be elicited in 96-100% patients with appendicitis (Adesunkanmi, 1993; Barber et al., 1997).^{10,11} Muscle guarding was found in

32(80.0%) of the patients which matched with other studies. A study by Adesunkanmi et al., 1993 observed muscle guarding was present in 81% cases.¹⁰ This present study showed that rebound tenderness in 30 (75.0%) cases, which shows similarity with two different studies done by Adesunkanmi, 1993.¹⁰

Peristalsis and compressibility of appendix was absent in 33 (82.5%) cases of this study and Probe tenderness in right iliac fossa was present in all patients. In a study by Sharma et al., 2007 found graded tenderness 54.2% which is not similar with present study¹³. In this study diameter of the lumen of appendix was >6mm, Wall thickness >3mm and echogenic fat was present in 82.5% 82.5% and 17.5% cases respectively. In a study by Helo et al., 2012 found diameter >6mm in 47% and Echogenic fat in 66% cases, which is not similar to my study findings. In this current study it was observed that 50% of the patients had collection around the inflamed appendix. Sharma et al., 2007 study findings regarding fluid collection didn't match with our study which was 19.4%.¹³

Among 40 patients in this study, 05 patients (12.5%) had appendicolith seen within the lumen of appendix. On the other hand study done by Sharma et al., 2007 among 118 patients, no patient was found with appendicolith.¹³

This present study showed that ultrasound was able to find appendicitis in 33 (82.5%) patients while 7 (17.5%) were negative for appendicitis. The diagnosis of all the patients has been confirmed by histopathology to elucidate the disease. Histopathology was taken as the gold standard test for the comparison. USG diagnosis was weighted against the histopathological diagnosis of the disease. Total 35 (87.5%) cases were confirmed on histopathology while 5 (12.5%) were found negative. Out of 35 positive cases on histopathology, 32 were positive on ultrasound that reveals 91.4% sensitivity, which is comparable with the study by Qureshi et al., 2014 that shows sensitivity of 91.5%.¹² This study findings was higher than some other study where sensitivity was 63.3% in the study of Sharma et al., 2007.¹³ Out of 5 negative cases on histopathology 4 were negative on ultrasound which shows specificity of 80.0 % which match with a study by Sharma et al., 2007 which shows specificity 82.1%.¹³ Our findings was lower than the study observed by Qureshi et al., 2014 that shows specificity 87.5%.¹²

The sensitivity of ultrasound in the diagnosis of acute appendicitis in the present study was 91.4%, specificity 80%, positive predictive value 96.7%, negative predictive value 57.1% and accuracy 92.5%, which might be comparable with the study by Qureshi et al., 2014 which reported about the specificity 80%, positive predictive value 96.4%, negative predictive value 73.7% and accuracy 90.7%.¹²

Conclusion

As abdominal ultrasound showed high validity parameters for the diagnosis of acute appendicitis, the study concluded

that ultrasonogram is a useful diagnostic modality in preoperative evaluation of acute appendicitis and can be used for planning of appropriate management.

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