Original Article

ACCURACY OF GRAY SCALE ULTRASOUND IN DIAGNOSIS OF ACUTE APPENDICITIS

Nayab Alia[*], Irshad Ahmad[**], Amir Hayat[***], Muhammad Sohail Amir[****], Benazir Omar[*****], Saima Ikram [*****]

[*]Assistant Professor, University medical and dental college, Faisalabad.
[**]Assistant Professor, Sargodha University, Sargodha.
[***]Psot Graduate Trainee in Radiology,Allied Hospital Faisalabad.
[****]Assistant Professor,University Medical and Dental College, Faisalabad.
[*****]Medical Officer, Madina Teaching Hospital,Faisalabad.

ABSTRACT

Objective:

To evaluate the role of Graded Compression Ultrasonography in the Diagnosis of Acute Appendicitis and its correlation with clinical signs and histopathological findings.

Study Design: Observational study.

Setting:

Department of Radiology and surgery Madina Teaching Hospital, Faisalabad.

Duration of study:

12 months from 1ST June 2009 to 30th May 2010.

Sample size:

100.

Material and Methods

All patients examined clinically, lab investigations, ultrasound and observed up to 06 hours.. The accuracy of ultrasonography in the diagnosis of appendicitis was compared with clinical diagnosis, laparotomy findings and histopathological examination reports and statistically analyzed by using SPSS 10

Results:

Out of 100 cases that underwent ultrasonography, 65 cases were sonographically positive for appendicitis and 02 cases were appendicular masses. Right iliac fossa tenderness, rebound tenderness and Rovsing's sign were the cardinal signs. The overall specificity of ultrasound was 89.74% and the sensitivity was 96.72%, positive predictive value is 93.65% and negative predictive value is 94.59%. In the diagnosis of acute appendicitis.

Conclusion:

Graded compression Ultrasonography is still a useful tool in the diagnosis of acute appendicitis in spite of sophisticated investigations like CT abdomen and laparoscopy; thus, reducing the cost of treatment and improve adverse outcome.

Key words: Ultrasonography, Acute Appendicitis, Accuracy, Diagnosis.

INTRODUCTION

Acute appendicitis is one of most common abdominal emergencies requiring the surgery. This disease process has been recognized for the hundred years, yet there has been no definite test to diagnose acute appendicitis. The diagnosis is still based on clinical features. The clinical diagnosis of appendicitis is difficult in a few cases. Approximately 20-33% of patients will present atypically.[1]

Delay in the diagnosis and surgery in these atypical cases of appendicitis result in perforation. This occurs in 17-39% of patients with appendicitis. The elderly and very young patients are at a higher risk [2].

To prevent high morbidity and mortality, most of the surgical authorities have advocated timely surgical intervention (early appendectomy), accepting that a significant number of normal appendices will be removed[3].

Although morbidity and mortality rate of acute appendicitis have been markedly reduced but rate of negative laparotomy is still high. The overall negative laparotomy rate is 15 to 47%and the female of reproductive age group have high negative appendectomy rate[3, 4.] The major contributing factor is non specificity of clinical features and lack of reliable test to allow direct visualization of appendix. In order to Improve the diagnostic accuracy, many tests have been used to aid the diagnosis of acute appendicitis including leukocyte count barium enema, CT scan, ultrasonography, MRI and Laparoscopy. Among these modalities, ultrasonography is simple, easily available, noninvasive, convenient and cost effective.

The ultrasound in the diagnosis of acute appendicitis was first popularized by Puylaert in 1986, one hundred years after the publication of first paper on acute appendicitis by Fitz.[5, 6]. In graded compression technique, where a uniform pressure is applied in RIF by a hand held US transducers. Normal and gas filled loops of intestine are either displaced from the field of vision or compressed between anterior and posterior abdominal walls. Inflamed appendix being incompressible is thus optimally seen.

The inflamed appendix is seen as blind ended tubular structure with laminated wall arising from the base of cecum. Puylaert reported the sensitivity of 89 % and specificity 100%.[6] Of his technique in the in the diagnosis of acute appendicitis. Ultrasonic probe tenderness can be elicited and patient himself can localize the most tender point and hence the site of inflamed appendix.

Corresponding Author:
Nayab Alia
Madina Teaching Hospital,Faisalabad, Pakistan.
Email: drnayab@yahoo.com

Objective of this study is to evaluate the role of graded compression ultrasonography used a s a diagnostic tool preoperatively comparing it a protocol where only clinical assessment was used as diagnostic protocols.

MATERIAL AND METHODS

It was a observational study. One hundred patients (70 female and 30 male) who met our inclusion and exclusion criteria were examined, presented in surgery emergency of Madina teaching hospital during study period of 12 months from 1st June to 30th May 2010. Patients were examined clinically and lab investigations were carried out. The ultrasound examination was performed with Neumo-XG machine using a linear array probe with 5MHz. All the sonographic assesments were performed by a single person using graded compression method. Sonographic findings were recorded. Diagnosis was also confirmed by surgical and histopathology findings. Two groups of patients described, one with positive diagnosis and other having negative laprotomy.

Inclusion Criteria:

- Male and female patients with age group of 5-30 years.
- Pain right iliac fossa,
- Fever
- Increased leucocytes count
- Mass in right iliac fossa.

Exclusion Criteria:

- Patient below 5 and above 30 year of age
- Previous history of laparotomy
- Patient with 3rd trimester pregnancy.
- Chronic infectious diseases like ileo-caecal tuberculosis
- Carcinoid tumours and other neoplastic lesions of the appendix

Sonographic finding of positive and negative cases were recorded along with operative findings and histopathology.

Sonographic Criteria:

The following accepted criteria were considered for the diagnosis of an inflamed appendix.

- Visualization of non-compressible appendix as a blind ending tubular a-peristaltic structure.
- Target appearance of ≥ 6mm (6 millimeters) in the total diameter on cross section (81%) maximal mural wall thickness ≥ (2mm).
- Diffuse hypoechogenecity (associated with a higher incidence of perforation).
- Lumen may be distended with anechoic /hyper echoic material.
- Loss of wall layers.
- Visualization of appendicolith (6%).
- Localized peri-appendiceal fluid collection.
- Prominent hyper echoic mesoappendix / pericaecal fat.
- Free pelvic fluid.

The criteria of negativity

- Non visualization of appendix
- Visualization of normal appendix with/without increased leucocytes count
- Tenderness in right iliac fossa.
- Operative findings were classified positive with and without perforated appendix, Negative appendectomy was defined as normal looking appendix on operation and absence of acute inflammation on histopathology. Positive cases included appendices showing acute and sub-acute changes seen histopathology. Perforation was described to occur when it was clearly visible on operation. Histopathological diagnosis was accepted as the final confirmation of diagnosis.

All cases which were treated and those cases of appendicectomies in which HPE was negative, were all considered as true negatives.

RESULTS

All the patients included in study had history of abdominal pain.. Tenderness in RIF was the most common sign elicited in all the cases (100%). Irrespective of the pathology, vomiting was found to be present in 91% of the cases. Murphy's triad of symptoms i.e. pain in abdomen, vomiting and fever held well in the diagnosis of acute appendicitis in our study .Table-1

Table-1 Clinical sign and symptoms

Symptoms	**No of cases**	**Percentage%**
Pain abdomen	100	100
Migration of pain	19	19
Vomiting		
Fever	85	85
Dysuria	41	41
diarrhea	05	05
	02	02
Signs		
RIF	100	100
Rebound tenderness	69	69
Guarding		
Tachycardia	21	21
Rovsing,s sign	50	50
Leukocytosis	43	43
Neutropenia	08	08
Puscell+RBC in urine	72	72
	81	81
	09	09

Among 100 cases for whom USG abdomen was done, 65 cases (65%) were sonologically positive for appendicitis and 02 cases were appendicular masses among USG negative cases (35%), an alternative diagnosis could be attained in more than half the number of cases, such as right ureteric colic, pelvic inflammatory disease, ovarian cyst and intestinal ascariasis. 21% of cases were inconclusive Table-2

Table-2 USG diagnosis of RIF pain

Pathology	No of cases
Acute appendicitis	65
Right ureteric colic	05
Pelvic inflammatory disease	02
Ovarian cysts	03
Appendicular mass	02
Ectopic preganancy	02
Inconclusive Findings	21

Table-3 Histopathological diagnosis

Histopathology diagnosis	No of cases
Acute appendicitis	59
Chronic appendicitis	05
Lymphoid hyperplasia	02
Total	66

Table-3 shows 59 cases of acute appendicitis, 05 of chronic appendicitis and 02 cases of lymphiod hyperplasia.

Table-4 Co- relation of USG diagnosis with HPE

Total no of cases	100
USG positive	65
USG negative	35
HPE positive	59
HPE negative	06
USG Negative Case Operated	09
HPE positive	04
HPE negative	05
Results	
Total cases of USG	100
USG positive	65
HPE positive	59
True positive	59
True negative	37
False positive	04
False negative	05

A total of 65 cases were diagnosed to have appendicular pathology by USG and all these patients were operated upon. Out of the 65 operated cases, 59 were HPE positive and 2 were found to be negative on HPE Table-4.

The sonologically negative cases were managed conservatively. In the conservative group of 35 cases, appendicectomy was done for 06 cases due to the persistence of symptoms and due to the surgeon's suspicion. Out of these 06 operated cases, 04 were reported to be acute appendicitis on HPE Table-4. 02 cases of appendicular masses were treated conservatively and were subjected to interval appendectomy after 3 months of interval.

Table-5 Evaluation of USG

Evaluation of USG	Value (%)
Sensitivity	96.72 (88.81, 99.1[1])
Specificity	89.74 (76.42, 95.9[1])
Positive predictive value	93.65 (84.78, 97.5[1])
Negative predictive value	94.59 (82.3, 98.5[1])

The overall specificity (89.74%) and sensitivity (96.72%), positive predictive value is 93.65% and negative predictive value is 94.59%o. Table-5.the diagnostic accuracy is high 94.59%

DISCUSSION

Diagnosis of Acute Appendicitis is not always straight forward. Sometimes presentation is so atypical that even the most experienced surgeon may remove normal appendix or sit on the perforated one.[7,8] Clinical decision to operate leads to removal of 20% of normal appendices to avoid the complications of missed or delayed diagonosis.

This was said to be the optimum balance between negative appendectomy and rate of perforation which were thought to be reciprocally related. This traditional concept is however being questioned recently.[9]

Incorporation of new diagnostic modalities in clinical decision making low negative appendectomy rate can be achieved without increasing the rate of perforation.[10,11]

Lewis et al. and Lee et al. found that the negative appendectomy rate was 15.7% and 16% respectively[13]. By comparison,

we had a low negative appendectomy rate, with only 4.0 false positives. Summa et al. found false positive results in only 7/308 of cases (2%)[14,15.]

In this study, in spite of the viability of ultrasound examination to detect and diagnose acute ppendicitis in approximately 89.74% of cases, 5 out of 100 patients were false negative (5%), which means 5 patients faced the risk of complications of perforated appendicitis.

The overall specificity and sensitivity were found to be 89.74% and 96.72% respectively, which showed that USG has a high specificity and sensitivity in diagnosing appendicitis. The overall specificity and sensitivity rates were at par with the values drawn by Skanne et al [16]Hahn et al [17]Tarzan Z et al [18,19] and Puylaert et al [6], Whose specificity values varied from 90- 100% and sensitivity ranges varied from 70-95%. The most widely studied new diagnostic modalities are CT Scan, Ultrasonography and Laparoscopy[21-23].

Fig-1 Gray scale image of inflamed appendix as blind ended tubular structure with cross section diameter of 8 mm and wall thickness of 2 mm.

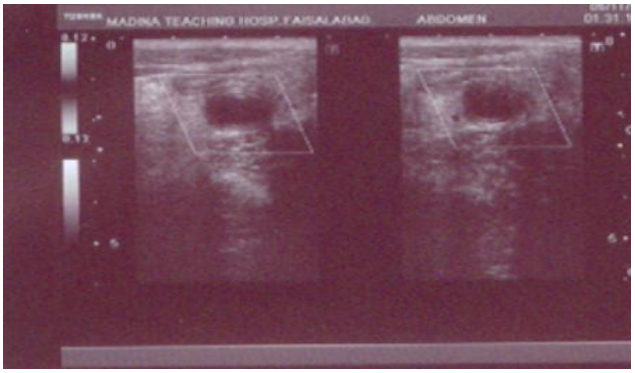

Fig -2. Inflamed appendix with with diameter f 7 mm and proment peri-appendiceal fat.

We have selected the Ultrasound because of its wide availability, simplicity, low cost, and noninvasiveness. Usefulness of US in the diagnosis of acute appendicitis is now established. When Puylart first introduced his graded compression method, he reported sensitivity of 89% and specificity of 100 %.6

There are certain draw backs in ultrasonography for acute appendicitis. The foremost important is the experience of the sonologist, as the procedure is highly operator dependent[19,20,21].

CONCLUSION

In conclusion ultrasound by graded compression technique is a useful adjuvant to the clinical armamentarium of the present day surgeon. It can reduce the negative appendicectomy rate without adversely

affecting the perforation rate particularly in equivocal cases. However US findings should be correlated carefully with clinical findings.

REFERENCES

1. Birnbaum BA, Wilson SR. Appendicitis at the millennium. *Radiology*,2000, 215:337–348.
2. Balthazar EJ et al. Acute appendicitis: CT and ultrasound correlation in 100 atients. *Radiology*, 1994, 190:31–35.
3. Hoffman J, Rasmussen O. Aids in the diagnosis of acute appendicitis; Br. J.Surg.1989; 76: 774-9.
4. Berry –J Jr,Malt RA.Appendicitis near its centenary, An Surg 1994;200(5):567-75.
5. Seal A. Appendicitis: a historical review. Can J Surg 1981;24(4):427-33
6. Puylaert JB. Acute appendicitis: US evaluation using graded compression. Radiology. 1986; 158(2):355-60
7. Hale DA, Molloy M, Pearl RH, Schutt DC, Jaques DP. Appendectomy: a contemporary appraisal. Ann Surg 1997;225(3):252-61
8. Zielke A, Hasse C, Sitter H, Rothmund M. Influence of ultrasound on clinical decision making in acute appendicitis: a prospective study. Eur J Surg 1998; 164:201-9.
9. Chan I, Bicknell SG, Graham M. Utility and diagnostic accuracy of sonography in detecting appendicitis in a community hospital. Am J Roentgenol. 2005; 184: 1809 –12.
10. Rettenbacher T, Hollerweger A, Macheiner P, Gritzmann N, Daniaux M, Schwamberger K et al. Ovoid shape of the vermiform appendix: a criterion to exclude acute appendicitis-evaluation with US. Radiology. 2003; 226:95-100.
11. Rodriguez DP, Vargas S, Callahan MJ, Zurakowski D, Taylor GA. Appendicitis in young children:Imaging experience and clinical outcomes. Am J Roentgenol 2006;186:1158-64.
12. Lee SL, Walsh AJ, Ho HS. Computed tomography and ultrasonographydo not improve and may delay the diagnosis andtreatment of acute appendicitis. *Archives of Surgery*, 2001,136:556–56.
13. Summa M et al. Integrated clinical-ultrasonographic diagnosis in acute appendicitis. Journal de Radiologie, 2007, 10:175–178.
14. Puig S,Hormann M,Rebhandl W,Felder Puig R,Prokop M,Paya K.US as primary diagnostic tool in relation to negative appendicectomy: six years experience.Radiology.2003;226:101-4.
15. Seymor I Schwartz, G.Tom Shires, Frank C. Spenner. Appendix ; Schwartz Principles of Surgery, international edition, Mc. Graw –Hill INC, Health Professions division, 7th edn. 1999; 1383-94.
16. George MJ, Siba PP, Charan PK, Rao RRM. Evaluation of Ultrasonography as a useful Diagnostic Aid in Appendicitis. Indian J Surg. 2002; 64: 436 – 9.
17. Skanne P, Amland P.F., Nordshus T. et al.Ultrasonography in patients with suspected acute appendicitis. A prospective study.Br. Jr. Radiol, 1990; 63:787-93.
18. Hahn HB, Hoepner FU., Kalle T et al.Sonography of acute appendicitis in children: 7 years' experience. Pediatric.Radiol 1998; 28:147-51.
19. Tarjan Z., Mako E., Winternitz T., et al.The value of ultrasonic diagnosis in acute appendicitis. Orv. Hetil . 1995; 136:713-7.
20. Lee SL, Walsh AJ, Ho HS. Computed tomography and ultrasonography do not improve and may delay the diagnosis and treatment of acute appendicitis. Arch Surg. 2001;136:556-62.
21. Lee JH, Jeong YK, Park KB, Park JK, Jeong AK, Hwang GC. Operator-dependent techniques for graded compression sonography to decect the appendix and diagnose acute appendicitis Am J Roentgenol 2006.

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