

## The Role of Ultrasound in the Diagnosis of Acute Appendicitis: A Prospective Study

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### ABSTRACT:

#### BACKGROUND:

Misdiagnosis of acute appendicitis is a common and crucial problem in general surgery, as the mortality and morbidity increase from 3 – 15 folds if appendix is perforated. Graded compression ultrasonography is one of the new diagnostic techniques that were introduced to improve the diagnostic accuracy and consequently the clinical outcome.

#### OBJECTIVE:

The aim of the current study is to assess the diagnostic accuracy of ultrasound in the diagnosis of suspected acute appendicitis.

#### METHODS:

One hundred-eighty patients admitted to the general surgical ward at Al Kindy Teaching Hospital from 1 June 2009 to 28 Feb. 2010. All patients were complaining of right iliac fossa pain and tenderness with a suspicion of acute appendicitis, a clinical assessment done for them by using modified Alvarado score (only patients with Alvarado score 5 and below were included). All patients were investigated by WBC count and general urine analysis. When the diagnosis of acute appendicitis was clinically equivocal, an abdominal ultrasound performed within 4 hours of admission. A dilated, Non-compressible appendix greater than 6 mm diameter, and edema and asymmetry of the appendicular wall were considered positive for the diagnosis of acute appendicitis. A normal appendix on histopathological examination with positive ultrasonographic findings was considered false positive result.

#### RESULTS:

The findings according to histopathological examination shows that 160 cases were true positive cases, 14 cases were found to be true negative, 1 case was false positive and 5 cases were false negative cases.

Ultrasonography yielded a sensitivity rate of 96% and specificity rate of 93%.

#### CONCLUSION:

Ultrasound by graded compression technique provides highly accurate, sensitive and specific test for clinically equivocal acute appendicitis.

**KEYWORDS:** acute appendicitis, ultrasonography.

### INTRODUCTION:

Acute appendicitis is the most common surgical emergency with a lifetime prevalence of one in seven<sup>(1)</sup>. The diagnosis of acute appendicitis is mainly clinical but because atypical presentation

and is correct in up to 80% of the patients<sup>(2)</sup>. As the consequences of missed diagnosis are problematic, the common surgical practice is to operate on doubtful cases rather than to wait and see till the diagnosis is certain, this resulted in negative appendectomy rate of 20 to 30 % and has been considered acceptable but this concept is being challenged at present day of quality assurance<sup>(3)</sup>. The removal of normal appendix is not a benign procedure and negative appendectomy carries a definitive morbidity<sup>(4)</sup>,

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Today's aware patient is also concerned about the removal of a normal appendix. In order to improve the diagnostic accuracy different aids were introduced like computer aided programs, different scoring systems, GIT contrast studies, CT. Scan, Ultrasonography, MRI and laparoscopy<sup>(5)</sup>. Among these modalities, ultrasonography is simple, easily available, noninvasive, convenient and cost effective<sup>(6)</sup>.

The ultrasound in the diagnosis of acute appendicitis was first popularized by PUYLAERT in 1986, in graded compression technique, where a uniform pressure is applied in RIF by a hand held US transducer, normal and gas filled loops of intestine are either displaced from the field of vision or compressed between anterior and posterior abdominal walls.

The most important error of sonography occurs when the inflamed appendix can not be visualized due to its position (i.e. when posteriorly located behind the cecum) or conversely when adequate bowel compression cannot be obtained due to excessive body fat.

Objective of this study is to evaluate the role of graded compression ultrasonography as a diagnostic tool for preoperative diagnosis of suspected acute appendicitis.

### **METHODS:**

*One hundred eighty* cases were admitted to Al-Kindy teaching hospital from 1 June 2009 to 28 Feb. 2010, were included in the study.

All patients complaining of right iliac fossa pain and tenderness with a suspension of acute appendicitis, a clinical assessment done for them by using modified Alvarado score.

The patients with abdominal mass, generalized peritonitis, patient with Alvarado score more than five, and those in whom CT scan of the abdomen was done preoperatively were excluded from the study.

Preoperative evaluation done to all patients in the form of leucocytic count, general urine analysis and plain radiography of the abdomen. Abdominal ultrasonography by graded compression technique was performed in patients with Alvarado score was 5 and below within 4 hours of admission; the radiologist involved in this study has experience of 20 years with special interest in graded compression technique, the device which was used in our study was simens (Prop 3.5 MHz, abdominal).

The Ultrasonography findings were recorded as positive and negative for acute appendicitis.

The criteria for positivity-included visualization of non - compressible tubular and blind ended a peristaltic structure with diameter of 6mm or more in right iliac fossa, the demonstration of Appendicoliths, probe tenderness, increased echogenicity of the periappendiceal fat and free intraperitoneal fluid particularly in RIF or pelvis. The criteria of negativity were Non-visualization of appendix or visualization of normal appendix with or without alternative diagnosis.

Patients were operated upon using a conventional open technique through a classical McBurney's incision. Extension of the wound was performed when deemed necessary and drains were left when indicated.

Patients were discharged after 1 – 2 days, all patients were kept on antibiotic medications postoperatively and stitches removed after 7 – 9 days.

Operative findings in our group of patients were classified as negative and positive.

Positive and negative appendices were regarded in accordance to the following criteria:

Negative appendectomy was defined as normal looking appendix on operation and absence of acute inflammation on histopathology.

Positive cases included appendices showing acute inflammatory changes on histopathology.

Statistical analysis of data was done by measurement of P values by fissure exact test , a P value <0.5 is refarded as significant.

### **RESULTS:**

One hundred-eighty cases of suspected acute appendicitis that were included in our study, 100 patients were male and 80 patients female.

The mean age group of the patients was 29 years (ranging from 6-42 years), ultrasounds and operations were done for all cases and the results were shown in table 1:

Ultrasound results were positive in 161 patients ,true positive in 160 patients ,false positive in 1 patients.

Ultrasound results were negative in 19 patients true negative in 14 patients and flase negative in 5 patients

Regarding operative finding, the results were acutely inflamed appendix 165 cases (91.67%) and normal appendix 15 cases (8.33%) .

**Table 1: Results of Graded Compression ultrasonography.**

Diagnosis	No. of Patient	Remarks	Percentage Value
True Positive	160	Documented by histopathology	88.88%
True Negative	14	Include 9 with rupture ovarian cyst, 1 with meckel's diverticulitis, 4 cases with PID	7.77%
False Negative	5	All the appendices were acutely inflamed	2.77%
False Positive	1	Acute salpingitis	0.55%

Sensitivity 96 % and specificity 93 %.

Statistical analysis showed that graded compression ultrasound yielded a sensitivity of 96.9%, specificity of 93.33%, diagnostic accuracy 96.6%, positive predictability power of 99.3% and negative predictability power of 73.6% .

**DISCUSSION:**

Diagnosis of acute appendicitis is not always easy; sometimes presentation is atypical that even the most experienced surgeon may remove the normal appendix or site on the perforated one (2) .

Clinical decision to operate leads to removal of (15 - 20%) of normal appendices to avoid the complications of missed or delayed diagnosis in equivocal cases (10) .

Incorporation of new diagnostic modalities in clinical decision making low negative appendectomy rate can be achieved without increasing the rate of perforation (11) .The most widely tools which used now such CT scan, Ultrasound, and Laparoscopy (12, 13) so we have selected the Ultrasound because of its wide availability, simplicity, low cost, and non - invasiveness.

Usefulness of US in the diagnosis of acute appendicitis is now established when *Puylaert* first introduced his graded compression method, he reported sensitivity of 89% and specificity of 100% (8) .

After the pioneer article of *Puylaert* in 1986, a number of workers have studied the role of ultrasound in management of suspected acute appendicitis; most of these authors have reported increased diagnostic accuracy when ultrasound was added to the clinical work up of these patients (6, 12 and 13) .

In our study sensitivity of graded compression ultrasound about 96% and specificity 93%.

The overall, sensitivity and specificity of the graded compression ultrasound examination in this study matched that of other prospective study. Baltazar at 1990, reported sensitivity of ultrasound 76%, Poortman at 1993 has reported the sensitivity to 80%, Baldisserotto at 2008 demonstrate sensitivity and specificity of compression sonography to be 98.5% and 98.2% respectively. (14)

Since then it has gained wide popularity being Non-invasive, less expensive than CT scan. Moreover, it can be safely used in pregnant women and children since there is no radiation hazard. The most frequent sonographic findings in acute appendicitis are the Non-compressibility of the appendix with diameter greater than 6mm.

In the present study, ultrasound applied only for patients whose clinical diagnosis was equivocal. Our data shows that ultrasound has improved the diagnostic accuracy of acute appendicitis. The number of un-necessary appendectomies was reducing from 15% in patients who had appendectomy on clinical ground only to 8% in those who had ultrasound in addition.

Ultrasound has been reported more helpful in clinically equivocal cases; Ultrasound should not be allowed to override the clinical acumen in extremes of the wide clinical spectrum of acute appendicitis (5) .

Although we have routinely used ultrasound in our study, we always considered the results in correlation with our clinical judgment so we operated upon those patients with *ALVARADO - SCORE 5* and below.

An important additional advantage of ultrasound in acute appendicitis is the diagnoses of other surgical conditions who presented with acute lower abdominal pain (15), as some of these conditions do not need surgery, so operation can be avoided.

Clinical evaluation is even more difficult in women of reproductive age since gynecological conditions can occur with symptoms mimicking acute appendicitis, misdiagnosis of appendicitis in women who are 20 – 40 years old are two times higher than those in male<sup>(16)</sup>.

The high specificity of ultrasound is useful for the differential diagnosis of associated pathology such as mesenteric lymphadenitis or gynecological disorder.<sup>(17)</sup>

### CONCLUSION:

Ultrasound by graded compression technique is useful adjuant to the clinical assessment of the present day surgeon; it can reduce the perforation rate and unnecessary appendectomies particularly in equivocal cases, and however ultrasound findings should be correlated carefully with clinical findings.

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