ORIGINAL ARTICLE

CROSS-SECTIONAL STUDY: STILL ULTRASOUND IS THE FIRST PARADIGM IN THE DIAGNOSIS OF APPENDICITIS

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ABSTRACT

Background: Appendicitis is one of the common cause of abdominal pain and surgical emergency. The diagnosis is mainly clinical, augmented by the imaging modality in which ultrasound still is a first paradigm. This study aims to assess the accuracy of ultrasound strategy in the diagnosis of acute appendicitis.

Methods: This retrospective cross-sectional validation study was conducted in General Surgery Department, Ziauddin University and Hospitals, Karachi Pakistan from 2012 to 2015 on patients who underwent Appendectomy. It concerned 200 cases of appendectomy following, prior ultrasound examination of lower right abdomen. In 126 cases ultrasonography clearly showed the acutely inflamed appendix. In 59 cases the appendix was not visualized. In15 cases ultrasound showed periappendicular fluid collection. Among 200 patients later shown in surgery to have appendicitis, ultrasonography was unequivocally positive in 114 patients (Sensitivity 95%) and 24 patients in whom appendicitis was definitely excluded according to ultrasound examination (specificity 70%).

Results: The gold standard for the diagnosis of appendicitis still requires histopathological confirmation after appendicectomy. Pooled sensitivity is 95% and specificity is 70%, ultrasound still remains the first line and extremely accurate measurement in the diagnosis of acute appendicitis.

Conclusion: We conclude that ultrasonography is our first line useful aid in patients referred with clinically suspected acute appendicitis. Ultrasonography has high accuracy in diagnosing acute appendicitis and reduces negative appendectomies. A non-compressible tubular structure of 7-9 mm in diameter of the appendix is the most accurate ultrasound finding.

KEY WORDS: Acute appendicitis, Histopathology, Ultrasound, Cross sectional study, Retrospective

INTRODUCTION

Appendicitis is as an inflammation of the inner lining of vermiform appendix that spreads to its other parts. In spite of diagnostic and therapeutic advancement in medicine acute appendicitis is one of the commonest abdominal emergency and appendectomy is in fact the most common abdominal emergency operation performed world over[1]. The clinical presentation of acute appendicitis may vary from nonspecific vague abdominal pain to the classic presentation of right iliac fossa pain, tenderness and rebound tenderness. Left untreated appendicitis has the potential for severe complications including perforation, sepsis and even death [2,3]. The diagnosis of appendicitis is clinical and essentially is based on history, clinical examination and routine laboratory tests [4]. The classic form of appendicitis may be promptly diagnosed and treated. However, when it presents with atypical features it poses a diagnostic challenge [5]. In such cases laboratory and imaging investigation may be useful in establishing a correct diagnosis. Ultrasonography has been suggested as a safer primary diagnostic modality for appendicitis with CT scan used secondarily when ultrasonograms are negative or inconclusive [6,7]. A normal healthy appendix usually cannot be viewed with ultrasound. When appendicitis occurs ultrasonogram typically demonstrates a non-compressible tubular structure of 7-9 mm in diameter [8,9]. The removal of normal appendix is not a benign proce-

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dure and negative appendectomy carries a definitive morbidity. Today's patients are aware and also concerned about removal of their normal appendix. In order to improve the diagnostic accuracy different techniques were introduced like some computer aided programs, different scoring methods, GIT contrast studies, CT scan, Ultrasonography, MRI and laparoscopy [10,12]. Among these modalities, still ultrasonography is the first paradigm, simple, easily available, noninvasive, convenient and cost effective [13, 15]. Diagnostic pitfalls in acute appendicitis organized if Alvarado score is 0-3 could be discharged, those with score of 4-6 undergo CT scan for further evaluation if ultrasound is inconclusive, and those with scores of 7 or above receive surgical consultation [16].

METHODS

This retrospective cross sectional validation study was conducted in General Surgery department in Ziauddin University and Hospitals in Karachi Pakistan from Jan 2012 to Dec 2015 on patients who underwent for appendectomy either open or laparoscopic. It concerned 200 cases of appendectomy performed following prior ultrasound examination of lower right abdomen. In 126 cases, ultrasonography clearly showed the appendix which was acutely inflamed. Whereas, in 59 cases the appendix was not visualized. 15 cases of ultrasound showed periappendicular fluid collection. 129 cases were identified positive for acute appendicitis with histopathological diagnosis. (Table I) We considered histopathology to be the gold standard for the accurate diagnosis of acute appendicitis, hence for this study the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of ultrasonography was based on the findings of histopathology. Data was entered into computer package SPSS 21 for statistical analysis. Sensitivity, specificity, positive predictive, negative predictive values and accuracy were calculated.

Table 1: Demographic variables, frequency and percentage between gender, age, presenting complains, ultrasound & histopathology

Demogrphics Variables	Yes	No
Abdominal pain	142(71%)	58(29%)
Nausea	110(55%)	90(45%)
Vomiting	37(18.5%)	163(82%)
Anorexia	59(29.5%)	141(71%)
Fever	110(55%)	90(45%)
Rebound Tenderness	166(83%)	34(17%)
Obturator sign	9(4.5%)	191(96%)
Psoas Sign	15(7.5%)	71(36%)
Gold standard	**Positive**	**Negative**
	129(65%)	71(36%)
Ultrasound	**Inflamed**	**Necrosed**
	126(63%)	15(08%)
Histopathology	**Inflamed**	**Necrosed**
	171(86%)	29(15%)
Age Groups	**≤18 Years**	**>18 Years**
	91(46%)	109(55%)
Score	**≤2.6**	**>2.6**
	100(50%)	100(50%)

STATISTICAL ANALYSIS

Data was entered and analyzed by SPSS version 21. Descriptive statistics calculated. Mean & standard deviation computed for age of the patients & Alvorado Scoring (Table 2). Whereas frequency and percentage were computed for gender, age group, different presenting complaints like abdominal pain, nausea, vomiting, anorexia and fever etc. Ultrasound and histopathology (Table 3) finally rate of categorical agreement between the ultrasound report, surgery and confirmed by histopathology. Percentage of discrepancies for positive and negative results between two procedures was also calculated. The procedures were considered to be in categorical agreement when they resulted in the same (e.g. positive or negative). Cohen's Kappa statistics was used to find percent agreement between ultrasound and histopathology method.

The agreement between two raters was evaluated by Kappa statistics for both groups separately. Kappa values ranged from 1 to 1 where 1 was considered representing perfect agreement between data sets. Kappa value ranging from 0.81 to 1.00, 0.61 to 0.80, 0.41 to 0.60, 0.21 to 0.40 and 0.00 to 0.20 were considered representing the strength of agreement as perfect, substantial, moderate, fair and slight respectively. A 2*2 table was constructed to determine the value of sensitivity, specificity, negative predictive value, positive predictive value and accuracy were calculated using the standard formula. Only those cases were taken as true positive which were positive by histopathological assessment.

Table 2: Frequency and percentage of presenting complains.

Presenting Complain	Frequency (f)	Percentage (%)
Abdominal pain	142	71.00%
Nausea	110	55.00%
Vomiting	37	18.50%
Anorcxia	59	29.50%
Fever	110	55.00%
Rebound tenderness	166	83.00%
Obturator sign	9	4.50%
Psoas sign	15	7.50%

Table 3: Analytic result for patients with ultrasound and Histopathology

Ultrasound	Histopathology		Cohen's Kappa Agreemant	P-Value
	Positive	Negative		
Positive	114(57%)	6(3%)	0.675	P<0.001*
Negative	24(12%)	56(28%)		

RESULTS

Among 200 study subjects, 109 (54.5%) were males and 91 (45.5%) were females, male patients are more predominant as compare to female patients. The age of the study subjects ranged from 11-55 years, however the mean and median age were found 30.06 ±10.92 years and 29 years respectively. 114 (95%) subjects were found positive for acute appendicitis with ultrasound examination. However 129 (65%) subjects were identified positive for acute appendicitis with histopathology diagnosis. Main symptoms observed were abdominal pain, nausea, vomiting, anorexia, fever, rebound tenderness & obturator sign respectively. 109(55%) patients belong to age >28 years. Agreement between the results of ultrasound and histopathological findings of acute appendicitis by Cohen's Kappa coefficient was found substantial (0.68 Table 3). Based on histological diagnosis, the sensitivity, specificity, and negative predictive value, positive predictive value and diagnostic accuracy was found 95%, 70%, 88.3%, 78.8% and 85% respectively. The diagnostic accuracy in male versus female patients were found 90.7%, 70.4% , 84.2% , 79.4% and 82.5% in comparison with female was 85.4% , 66.6% ,79.6% ,75% and 78% respectively. Finally in male have high accuracy as had acute appendicitis in comparison with female patient.

DISCUSSION

Acute appendicitis is one of the most common etiology for abdominal emergency which could lead to prompt appendectomy. It is in fact the most common abdominal emergency operation performed world over. It's a very common pathology in diagnosis but still remain challenging because clinically it can mimic many other conditions [17]. The diagnosis of appendicitis is clinical and essentially is based on thorough history, clinical examination and routine laboratory tests. The classic form of appendicitis may be promptly diagnosed and treated. However, when it presents with atypical features, it poses a diagnostic challenge. In such cases, laboratory and imaging investigation may be useful in establishing a correct diagnosis, ultrasonography has been suggested as a safer primary diagnostic modality for appendicitis, with CT scan used secondarily when ultrasonograms are negative or inconclusive [18, 20]. In suspected patients with equivocal sign of acute appendicitis, it is the only accessory modality that can help the surgeon to make a correct diagnosis. In our study appendicitis prevails mostly in young male patients. Ultrasonography had 95% sensitivity, 70% specificity, PPV is 88.3%, NPV is 78.8% with 85% diagnostic accuracy. Significant P value is < 0.05 and resulted high accuracy in ultrasound still is a first line paradigm in the diagnosis of acute appendicitis. In some studies ultrasound has a sensitivity ranging from 49 to 90 %, a specificity ranging from 47 to 100 %, a positive predictive value (PPV) of 84 to 94.8 %, and an overall accuracy of 72 to 94 % in the diagnosis of acute appendicitis [21,25]. In this study ultrasonographic, intraoperative and histopathological findings were statistically insignificant (P≥0.05). The sensitivity, specificity, positive predictive value, negative predictive value and accuracy percentage of ultrasonography in the diagnosis of acute appendicitis were 85.7%, 100%, 100%, 6.7% and 85.9% respectively [26].

CONCLUSION

Current study showed that there is still a high degree of accuracy as first line in diagnosing acute appendicitis with ultrasound, P-value is < 0.05* Significant. It is thus recommended that ultrasound should be considered as an important first line modality in patient's evaluation in all clinically suspected cases of acute appendicitis but cannot be relied on to the exclusion of surgeon's careful and repeated evaluation for a better and prompt management decision of the patient's care. However, the diagnosis should be considered with a non-compressible tubular structure of 7-9 mm in diameter of the appendix and is the most accurate ultrasonographic finding.

ACKNOWLEDGEMENTS

Prof.Shafique-Ur-Rehman (General Surgery), Dr.Haris Rasheed (Consultant Laparoscopic & General Surgeon), Dr.Haider Naqvi (Epidemiologist & Consultant of Psychiatry) are acknowledged for their support.

CONFLICT OF INTEREST The authors don't have any disclosable interest.

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