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Original Research Article

Advantage of ultrasonography in the diagnosis of acute appendicitis at Al-Karama Teaching Hospital

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ABSTRACT

Background: The clinical diagnosis of acute appendicitis remains a challenge to surgeons. Different aids were introduced to improve the diagnostic accuracy. Among these modalities, ultrasonography is simple, easily available, non-invasive, convenient and cost effective. The aim of the study was to determine the validity of ultrasound in diagnosis of the acute appendicitis in those with clinically diagnosed patients.
Methods: A cross sectional study was carried out in Al-Karama teaching hospital for thirty months from the period of 1st June 2016 to 1st December 2018. All patients with suspected appendicitis underwent clinical evaluation then sent for US. Results of surgeries, where relevant, were compared against US results. Positive and negative appendices on histopathology were regarded in accordance to the criteria which was negative appendectomy was defined as normal looking appendix and absence of acute inflammation on histopathology while positive cases included appendices showing acute inflammatory changes. Sensitivity, specificity and overall accuracy was calculated.
Results: A total of 435 patients with suspected appendicitis, males 224 (51.49%) and females 211 (48.50%) were included in present study. There were no significant differences between patients with positive and negative histopathology findings regarding presenting symptoms. There was a significant association between (cough sign, localized tenderness sign and pointing sign) and patients with positive histopathology findings. Regarding to the validity results of ultrasound in comparison to histopathology findings were accuracy 87.6%, sensitivity 87.8%, specificity 85.3%, positive predictive value 98.6% and negative predictive value 62.8%.
Conclusions: The ultrasonography had a good accuracy, sensitivity and specificity in diagnosing acute appendicitis cases. Negative with ultrasonography results should be re-examined with different diagnostic technique like CT-scan.

Keywords: Accuracy, Appendicitis, Iraq, Ultrasonography, Validity

INTRODUCTION

The vermiform appendix is a worm shaped tubular structure projecting from the blind end of the caecum.[1] At birth, the appendix is short and broad at its junction with the caecum but differential growth of the caecum produces the typical tubular structure by about the age of two years. During childhood, continued growth of the caecum commonly rotates the appendix and may occupy one of several locations. Retro-caecal and retro-colic location in (74%), pelvic in (21%), sub-caecal in (1.5%), pre-ileal in (1%), pre-ileal in (1%) and para-caecal in (2%). The appendix varies in length from 2-20cm, the average being about 9cm, it is longer in the child than in

the adult and may atrophy and become smaller after mid-adult life.[2]

Early reports of perityphlitis and typhlitis in the 19th century appeared to describe clinical features of right sided abdominal pain. Confusion over this right lower quadrant pain existed until Reginald H. Fitz coined the term appendicitis in 1886 and correctly described the appendix as the primary source of inflammation in acute typhlitis.[3]

Acute appendicitis is the most common surgical abdominal emergency with a life time prevalence of 1 in 7 individuals.[4] The diagnosis is mainly clinical but because of myriad presentation this is true in up to 80% of the patients.[3] As the consequences of missed diagnosis are dire, the common surgical practice has been advocated to operate on doubtful cases rather than to wait and see till the diagnosis is certain. This resulted in negative appendicectomy rate of around 15% has been considered acceptable.[5,6]

In order to improve the diagnostic accuracy, different aids were introduced like different scoring systems, computer aided programs, ultrasonography, CT scan, MRI, GIT contrast studies and laparoscopy.[7] Among these modalities, ultrasonography is simple, easily available, non-invasive, convenient and cost effective.

The ultrasonographic diagnosis of acute appendicitis was first introduced by Puylaert in 1986, one hundred years after the publication of first paper on acute appendicitis by Fitz.[8-10] The lifetime risk of developing appendicitis is 8.6% for males and 6.7% for females with the highest incidence in the second and third decades.[11-12] The rate of appendectomy for appendicitis has been decreasing since the 1950s in most countries.[13,14]

With the advent of advancement in imaging techniques an important role in diagnosis of appendicitis without delay or clinically missed patients.[15] Ultrasonography is universally available, cheap and easy to use and doesn't involve the use of radiation that has the potential for highly accurate imaging in patients with suspected acute appendicitis.[16-20] The aim of this study was to evaluate the utility of using US in the diagnosis of acute appendicitis.

METHODS

A cross sectional study was carried out at Al-Karama Teaching Hospital. The study extended for thirty months from 1st June 2016 to 1st December 2018. All patients who diagnosed and with positive criteria of appendicitis were included in this study and at last the sample size was 435 patients. The patient with appendicular mass was excluded from this study. After full physical examination, GUE, WBC the patients send for the U/S and the diagnosis by ultrasound. To detect the vermiform appendix graded compression technique was used. 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 lower quadrant, the demonstration of appendicoliths, probe tenderness, increased echogenicity of the peri-appendiceal 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.

Positive and negative appendices on histopathology were regarded in accordance to the criteria which were negative appendectomy was defined as normal looking appendix and absence of acute inflammation on histopathology while positive cases included appendices showed acute inflammatory changes.

Sensitivity (also called the true positive rate) is the ability of test to identify correctly those who have the disease (true positive).

$$\text{Sensitivity} = a/a+c \times 100\%$$

Specifity (also called the true negative rate) is the ability of test to identify correctly those who do not have the disease (true negative).

$$\text{Specifity} = d/b+d \times 100\%$$

Positive predictive value is a probability that person have disease actually has the disease giving that he or she tests positive.

$$PV+ = a/a+b \times 100\%$$

Negative predictive value is a probability that person have disease actually has the disease giving that he or she tests negative.

$$PV- = c/c+d \times 100\%$$

$$\text{Accuracy of test} = (TP+TN)/\text{Total}$$

Where, TP=True Positive, TN=True Negative.

RESULTS

A total of 435 patients with suspected acute appendicitis were included in this study with age range from (8-50) years (mean age as 23.49 years). There were 224 males (51.49%) and 211 females (48.50%) with M:F ratio was (1.06:1), mean age of male patients was (22.51 years) and mean age of female patients was (24.51 years), no association between mean age of male and female patients with histopathological result. Most commonly affected age group was 10-19 years (20% of total patients). The number of patients with positive histopathology was 401 patients and that for negative histopathology 34 patients with no association between histopathological result and gender (Table 1).

Table 1: Comparison of mean age of patients according to gender and histopathological results.

Variables		No.	Mean
Gender	Male	224	22.51
	Female	211	24.56
Histopathology	Positive	401	23.68
	Negative	34	21
Total		435	23.49
Range age (8-50 years)			

There were no significant differences between patients with positive and negative histopathology findings regarding presenting symptoms (anorexia, vomiting, diarrhea, relative constipation, generalized abdominal pain, migratory pain to RIF, peri-umbilical abdominal pain and fever) as shown in Table 2.

There was a significant association between (cough sign, localized tenderness sign, and pointing sign), and patients with positive histopathology findings.

Table 2: Association between histopathological results and symptoms.

Symptoms		Histopathology			
		Positive		Negative	
		No.	%	No.	%
Anorexia	No	63	88.7	8	11.3
	Yes	338	92.85	26	7.15
Vomiting	No	317	93.2	23	6.8
	Yes	64	85.3	11	14.7
Diarrhea	No	381	93.4	27	6.6
	Yes	20	74.1	7	25.9
Relative constipation	No	75	85.2	13	14.8
	Yes	326	93.9	21	6.1
Migratory pain to RIF	No	82	89.1	10	10.9
	Yes	319	93	24	7.0
Generalized abdominal pain	No	243	91.7	22	8.3
	Yes	158	92.9	12	7.1
Peri-umbilical abdominal pain	No	141	93.4	10	6.6
	Yes	260	91.5	24	8.5
Dysuria and frequency	No	197	94.7	11	5.3
	Yes	204	89.8	23	10.1

Table 3: Association between histopathological results and physical signs.

Physical signs		Histopathology			
		Positive		Negative	
		No.	%	No.	%
Fever	No	201	94.8	11	5.2
	Yes	200	93.9	13	6.1
Cough sign	No	106	82.8	22	17.2
	Yes	295	96.1	12	3.9
Localized tenderness	No	44	74.6	15	25.4
	Yes	357	94.9	19	5.1
Rebound tenderness	No	85	89.5	10	10.5
	Yes	316	92.9	24	7.1
Rovsing's sign	No	281	92.4	23	7.6
	Yes	120	91.6	11	8.4
Psoas sign	No	330	91.67	30	8.33
	Yes	71	94.66	4	5.34
Obturator sign	No	364	91.5	34	8.5
	Yes	37	100.0	0	-
Pointing sign	No	163	82.7	34	17.3
	Yes	238	100.0	0	-

No significant differences between patients with positive histopathological findings and those with negative findings regarding physical signs (fever, rebound tenderness, Rovsing's sign, psoas sign and obturator sign) (Table 3).

Four hundred and thirty-five cases of suspected acute appendicitis that were included in this study, ultrasounds and histopathological examination were done for all cases. Ultrasound results were positive in 357 patients, true positive in 352 patients and false positive in 5 patients. Ultrasound results were negative in 78 patient's true negative in 49 patients and false negative in 29 patients. Regarding histopathological finding, the results were acutely inflamed appendix 401 cases (92.18%) and normal appendix 34 cases (7.82%).

Statistical analysis showed that graded compression ultrasound yielded a sensitivity 87.6%, specificity 87.8%, diagnostic accuracy 85.3%, positive predictability power of 99.6% and negative predictability power of 62.8%. All these findings shown in Table 4.

Table 4: Validity of ultrasound diagnosis of acute appendicitis compared with histopathological examination as gold standard.

Variables	Histopathology		
	Positive	**Negative**	**Total**
Ultrasound	352	5	357
	49	29	78
	401	34	435
Sensitivity=87.8%			
Specificity=85.3%			
Accuracy=87.6%			
+ve predictive value=98.6%			
-ve predictive value=62.8%			

DISCUSSION

Even though the diagnosis of acute appendicitis is still thought to be a clinical one, a significant number of patients have normal appendices at surgery. Wrong diagnosis of appendicitis has led to a high rate (around 15 %) of unnecessary removal of the normal appendix.

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.[21]

In this study, the accuracy rate of US in diagnosing acute appendicitis in comparison to histopathology results was 87.6% with sensitivity and specificity 87.8% and 85.3%, respectively, which is agree with the study done in north of Iraq by Hiwa O. When he mentioned that the accuracy and sensitivity of US was 83.3%, 82.1% but the specificity (100%) was inconsistent with the present study.[22] Moreover, these findings are inconsistent with results of other Iraqi study by Hanna MK et al, which reported US accuracy of 96.6%, sensitivity 96% and specificity 93%.[23] The result agree with result of Pinto F et al, study in Italy which showed overall sensitivity of US as 86%, specificity 81% and accuracy of 84%.[24]

However, the ultrasound accuracy in diagnosing acute appendicitis was better than results of Parsijani PJ et al, study in Iran which found US accuracy as 73.6%, sensitivity as 75% and specificity as 69.2%.[25] These differences in result of studies were mentioned might be attributed to differences in sample size, US technique and operator's experiences. Ultrasound has also some limitations as well, for example appendix can be covered by overlying gas or overriding boney pelvis. The site of the appendix can also influence on the possibility of evaluation of appendix by ultrasound (e.g. a retro-cecal appendix). Obesity is another factor influencing the optimality of sonography.[26-28]

Positive predictive and negative predictive values of US in present study were 99.6% and 62.8%, respectively. The negative predictive value inconsistent with previous Iraqi study by Hanna MK et al, this should lead to the conclusion that when ultrasound report revealed that the appendix was normal, so author should more rely on the clinical judgment than the report or perhaps use another modality such as CT-scan if possible.[23]

There were showed a significant difference between positive and negative predictive value of sonography confirming the results by Nasiri et al, (97.4% for PPV in comparison to 25% for NPV) and Hiwa O (100% for PPV in comparison to 26.6% for NPV).[22,29] The results emphasize again that a positive ultrasonography for appendicitis is strongly in favor of a diagnosis of acute appendicitis. However, a negative ultrasound is not sufficient to rule out the diagnosis and discharge the patient.

The present study revealed a significant association between dysuria and frequency symptoms with negative histopathology findings of suspected appendicitis patients. This finding was similar to results of Boyd CA et al, study in USA which concluded that causes and symptoms of acute abdominal pain are varied and the diagnosis was not as clear as it may seem, particularly in female patients.[28] Right lower quadrant pain is rarely the major clinical finding of an acute urological illness but it can nevertheless be the presenting symptom of pyelonephritis, urinary colic, cystitis or a tumor of the urinary tract. In all of these cases, it is usually accompanied by other symptoms or signs pointing to the urological origin of the problem, including macro or micro hematuria, renal angle tenderness and dysuria, oliguria, pyuria and frequency.[30-32]

CONCLUSION

The ultrasonography had a good accuracy, sensitivity and specificity in diagnosing acute appendicitis cases. Encouraging the radiologists and surgeons to relay on ultrasound diagnosis of acute appendicitis among clinically suspected patients to avoid perforation and other complications. Negative with ultrasonography results should be re-examined with different diagnostic technique like CT-scan.

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