

*Original Research Article*

**Value of Ultrasonography in Acute Appendicitis in Patients with Modified Alvarado Scoring System Score of 5 & 6**

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**Abstract**

Acute appendicitis is one of the most common and challenging surgical emergencies. Ultrasound [US] is widely available , highly accurate imaging modality in patients suspected to have acute appendicitis, this study was done to assess the value of US in evaluation of suspected acute appendicitis patients with Alvarado Scoring System [MASS] of 5 & 6 . In this prospective study a total of (100) patients with clinically suspected acute appendicitis and with Alvarado score between 5 & 6 underwent US examination of the abdomen The accuracy of ultrasonography in the diagnosis of appendicitis was compared with clinical diagnosis, laparotomy findings and histopathological examination reports.. The patients were divided into two groups: group A included those for whom surgery was done & the final diagnosis was established depending on the surgical finding &/or histopathology results & this group comprised (65) patients . Group B comprises patients who did not undergo surgery ,these patients were followed up until their improvement & discharge from the hospital & this group included (35) patients. The overall specificity of ultrasound was 88% and the sensitivity was 89% in the diagnosis of acute appendicitis in patients with MASS of 5 & 6 .

US is a valuable tool in diagnosing acute appendicitis in patients with MASS (5 & 6). When the clinical sign and symptoms are combined with US, the diagnostic accuracy is significantly high.

**Key words:** Appendicitis, Ultrasonography, Modified Alvarado Scoring System (MASS)

**تقييم السونار في التهاب الزائدة الدودية الحاد مع الاخذ بنظر الاعتبار تقييم الفارادو المعدل**

**الخلاصة**

التهاب الزائدة الدودية الحاد واحد من اكثر حالات الطوارئ الجراحية شيوعا وتحديا . الامواج فو الصوتية [السونار ] هو احد الطرق المستخدمة على نطاق واسع في حالات اشتباه التهاب الزائدة الدودية . اجريت هذه الدراسة في الفترة ما بين تشرين الاول 2013 الى تموز 2014 في مدينة الامامين الكاظمين [ع] في بغداد و شملت 100 مريضا اخذوا الى المستشفى و هم يشكون سريريا من اعراض التهاب الزائدة الدودية الحاد وتقييم الفارادو لهم بين [5-7] حيث اجري لهم فحص السونار . جميع حالات الموجبة التي شخصت اصابتها بالتهاب الزائدة الحاد بواسطة السونار والحالات السالبة المشتبها بها من قبل الجراح اجريت لها عملية رفع الزائدة الدودية وارسلت العينات للفحص النسيجي.دقة السونار في تشخيص التهاب الزائدة الدودية الحاد تمت مقارنته مع الشخيص السريري ونتائج العمليات والفحوص النسيجية. قسم المرضى الى مجموعتين ,المجموعة الاولى وتشمل 65 مريض شكلوا [65 %]من مجموع المرضى أجريت لهم عملية استئصال الزائدة الدودية وارسلت العينات للفحص

النسجي ، المجموعة الثانية وتشمل 35 مريض شكلوا [35%] من مجموع المرضى لم تجرى لهم عملية استئصال الزائدة الدودية، تمت متابعتهم لحين تحسنهم وخروجهم من المستشفى. كانت خصوصية الموجات فوق الصوتية 88% وبلغت الحساسية 89% في تشخيص التهاب الزائدة الدودية الحاد. الامواج فوق الصوتية هي أداة قيمة في تشخيص التهاب الزائدة الدودية الحاد في المرضى الذين تقيمهم بواسطة الفارادو بين 5 و 7. عندما يتم الجمع بين علامة السريرية والأعراض مع السونار ، ودقة التشخيص ترتفع بشكل ملحوظ.

**الكلمات المفتاحية :** التهاب الزائدة الدودية الحاد ، الامواج فوق الصوتية [ السونار ] ، تقييم الفارادو المعدل.

## **Introduction**

**A**cute appendicitis is one of the most common and challenging surgical emergencies and is the primary source of inflammation in acute typhlitis, it can lead to appendiceal perforation and peritonitis, which are concomitant with high mortality and morbidity [1, 2] . An infected appendix appears to be more likely to rupture during pregnancy, especially in the third trimester of pregnancy , possibly because of delay in diagnosis and intervention [3, 4]. Making the decision for surgical operation based only on the patient's signs and symptoms results in removing normal appendices (negative appendectomy) in 15% to 30% of cases. [5-7]. The rational approach is to decrease the negative appendectomy as well as appendiceal rupture rates ,for this reason, a number of diagnostic modalities have been proposed, including laparoscopy, clinical scoring systems, ultrasonography (US), CT scans and MRI [8-10].

Ultrasound is widely available, inexpensive modality with the potential for highly accurate imaging in the patient suspected to have acute appendicitis, and safe for use in children and pregnant women [11]. To detect the vermiform appendix graded compression technique described by puylaert [12] was used to displace and compress bowel loops ,decrease the distance between the transducer and the bowel and to assess if

a lesion is rigid or not. The criteria for the diagnosis of appendicitis by US are Blind-ending tubular structure at the point of tenderness, non-compressible appendix, no peristalsis, diameter 7 mm or greater, appendicolith casting acoustic shadow, high echogenicity non-compressible surrounding fat and surrounding fluid or abscess [13].

A number of scoring systems have been advocated to minimize the number of negative appendectomies; they combine clinical, laboratory, and ultrasound parameters to increase the security of diagnosis [14] .

In 1986, Alvarado [15] described a scoring system, modified Alvarado scoring system, which has been validated in adult surgical practice. This scoring system includes seven variables: three symptoms (migrating pain from the umbilicus to the right iliac fosse, anorexia, and vomiting), three signs (tenderness, rebound tenderness, and pyrexia) and two laboratory data (leukocytosis ) yielding a total score of 9 [15]. The MASS has been shown to be a quick and inexpensive diagnostic tool in patients suspected of suffering acute appendicitis [16][table1].

It has been suggested that patients with MASS scores of 7 or higher should be operated on [17]. We aimed of the study to assess the value of US in evaluation of suspected acute appendicitis patients with Alvarado Scoring System of 5 & 6.

**Table 1 :** Modified Alvarado Scoring System

Item	Score
Migratory right iliac fossa pain	1
Anorexia	1
Nausea/vomiting	1
Fever > 99.5°F (37.5°C)	1
Tenderness in the right iliac fossa	2
Rebound tenderness in the right iliac fossa	1
Leukocytosis	2
<b>Total</b>	<b>9 points</b>

### **Materials and Methods**

This prospective study was conducted from October 2013 through July 2014 at the emergency unit of Al-Imamain Al-kadhmain medical city, Baghdad, Iraq. A total of (100) individuals (45 males & 55 females) with age range between (10-40 years) with clinically suspected acute appendicitis were included in the study. Two general surgeons assessed each individual case clinically & each patient was sent for the necessary laboratory tests. Then for each patient the MASS score was set & only cases with MASS score of 5 & 6 were enrolled in the study. The patients underwent US examination of the abdomen by the radiologist using Philips HD11-XE high resolution real-time ultrasound machine utilizing 3.5 MHz convex probe and 7.5 MHz linear probe. No special preparation was required. The general abdominal ultrasound examination was followed by focused examination of the right side of the abdomen using graded compression technique starting from the tip of the liver and proceeding to the pelvic brim. The appendix, whenever detected by US was assessed whether inflamed or not by applying according to the conventional signs of acute appendicitis. For those patients who underwent surgery, the surgical notes were recorded and correlated with the result of histopathology. While for those patients who did not have surgical intervention, follow up was performed until their improvement & discharge from the hospital. The sensitivity and specificity of

US were calculated based on the surgical findings & histopathology results

### **Results**

This study included 100 patients with clinical diagnosis of acute appendicitis with MASS of 5 & 6. The patients were divided into two groups:

group A included those for whom surgery was done, this group comprises (65) patients. Group B comprises patients who did not undergo surgery & this group includes (35) patients.

Analysis of group A [65 patients]

In this group, 25 patients were males & 40 patients were females

- The US diagnoses were as follows: 53 cases [(81.5%): acute appendicitis, 2 cases (3 %): appendicular mass, & 10 cases [15.3 %] had normal US scan.

- The Surgical results were as follows: 54 patients had Inflamed looking appendix [83%], 2 had Appendicular mass [3%] and 9 cases [13.8%] had negative surgical findings

- The histopathological results were as follows: 52 patients [80%] patient had Inflamed appendix, 4 patients [(6.1%)] had Lymphoid hyperplasia and 9 cases [13.8 %] had normal appendix.

The positive & negative predictive values for US are [90%] & [86%] respectively, the sensitivity, specificity & accuracy are [89%], [88%] & [89%] respectively.

The ultrasound findings among true & false positive cases of acute appendicitis [as proved by surgery and HP] are summarized at table 2:

**Table 2:** Distribution of US finding in true & false positive cases of acute appendicitis

The sign	True positive cases	False positive cases
Visibility of appendix totally	36	0
Visibility of appendix partially	12	2
Non compressibility	48	1
Obstructing faecolith	10	1
Diameter of appendix>6 mm	48	1
Inflamed periappendiceal fat	30	3
Appendiceal mass	2	0
Appendiceal abcess	0	0
No peristalsis	48	0

\*The pt. had either a single or a combination of the above findings

The Alvarado parameters among true & false positive cases of acute appendicitis [proved by surgery and HP] are summarized in table 3:

**Table 3:** modified Alvarado percentage in finding in true positive & true negative cases of acute appendicitis of group A

Symptom/sign/test	True positive cases	True negative cases
Migration of pain	11	3
Anorexia	50	7
Nausea/vomiting	50	7
RIF tenderness	56	9
Rebound tenderness	38	2
Raised temperature	20	3
Leucocytes count>10x10/L	40	5

**Analysis of Group B (35 patients)**

In this group, 20 patients were males [57%] & 15 patients were female [43%] Among 35 patients in group [B]) an alternative diagnosis could be obtained in 20 cases, such as ureteric stone, ovarian cyst & PID, while the findings were

inconclusive in 15 patients, these patients were followed up until their improvement & discharge from the hospital.

The most frequent Alvarado parameters among group B cases are summarized at table 4.

**Table 4:** Modified Alvarado percentage in group B

Migration of pain	6	17 %
Anorexia	31	88 %
Nausea/vomiting	31	88 %
RIF tenderness	35	100%
Rebound tenderness	23	65%
Raised temperature	12	34 %
Leucocytes count>10x10/L	25	71 %

### **Discussion**

In this study US was found to be a useful imaging tool for suspected appendicitis and it enhances the diagnostic accuracy in equivocal cases and reduce the number of negative appendicectomies.

In this study, Of the 65 cases of appendicitis [group A], pain in abdomen, nausea and vomiting were the predominant clinical symptoms, but they are not specific for acute appendicitis. Tenderness in RIF was present in almost all cases [100%], raised temperature in [37%] rebound tenderness in [70%], nausea and vomiting in [90%]. These findings are comparable with the findings of the study by Rosemary Kozar et al [18].

Leucocytosis was present in 73% of the cases correlate with a study of 100 patients by Tauro LF et al who showed that leucocytosis was present in 75% of cases of acute appendicitis [19].

In this study, One or more of US signs were found in 55 cases out of 100 cases can be sub divided into subgroups as follows: In our study, of 100 patients who underwent ultrasonography, appendix was visualized in 55 patients [55%]. Of these, 50 had acute appendicitis on surgical and histological examination giving a positivity of visualization of [91%]. These results were similar to Rajat who reported the positivity of visualization of appendix on ultrasonography to be as high as 96%[20]. Visible appendix is not enough for diagnosis of acute appendicitis, because the normal appendix nowadays is frequently

visualized. So other criteria are needed for confirmation of diagnosis.

Non-visualization of the appendix with sonography does not completely exclude acute appendicitis, particularly in the patients who are obese or where abdomen is difficult to compress.

A negative appendicectomy rate of 11% was observed in our study. This is similar to the report by Rajat Patra of 11.2% [20]. non compressibility: This sign was detected In all visible inflamed appendices (100%). In comparison with The study of Jeffery et.al. detectability was [97%] [(21).

Obstructing faecolith or appendicolith was seen in 10 patients only [20%] approximate to (30%) mentioned by puylaert [22].

We could detect the increase in diameter in all inflamed appendices[100%]. Compared to (100%) by quillin [23]. The range of diameter was 6-24 mm with a mean of 10.8 mm.

Inflamed periappendiceal fat sign was detected in 30 patients out of 50 [60%] is considered high specific but low sensitive sign Compared to[51%] by quillin[23].

Abdominal US could diagnose 55 cases as appendicitis out of a total of 100 cases who presented with clinical features similar to appendicitis and modified Alvarado score [5,6], from which true positive cases of appendicitis were found after surgery and HPE. George et al reviewed a total 140 cases of appendicitis in which they could diagnose 70 cases as appendicitis by US [24].

The overall specificity and sensitivity were found to be 88% and 89% respectively, which showed that US 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 [25], Hahn et al [26], Tarzan et al [27] and Puylaert et al [12], whose specificity values varied from 90-100% and sensitivity ranges varied from 70-95%.

### **Conclusion**

US is a valuable tool in diagnosing acute appendicitis in patients with MASS [5&6]. when the clinical sign and symptoms are combined with US the diagnostic accuracy is significantly high.

US helps in diagnosis other causes of RIF pain which helps in excluding appendicular pathology. It should be emphasized that US does not replace clinical diagnosis, but is a useful adjunct in the diagnosis of acute appendicitis

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