

## Comparison of clinical examination and ultrasonography in the diagnosis of acute appendicitis

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### Abstract

This study was undertaken to compare clinical examination and ultrasonography (USG) in the diagnosis of acute appendicitis and to establish their accuracy in the diagnosis of acute appendicitis. 100 patients who presented to the emergency department with a clinical diagnosis of acute appendicitis were subjected to USG. After USG a specific diagnosis was made. Patients underwent appendicectomy on the basis of the surgeon's final clinical impression after correlating with USG findings. Histopathological examination of the appendicectomy specimen was taken as the gold standard for the diagnosis of acute appendicitis. Appendicectomy was performed in 74 patients. Out of these 74 cases, only 66 had appendicitis on histopathological examination. Eight normal appendixes were removed. Twenty-six patients were prevented from surgery after USG had shown an alternative diagnosis for the cause of pain in right iliac fossa. Clinical examination thus had a sensitivity and Positive Predictive Value (PPV) of 66%. USG examination made a preoperative diagnosis of acute appendicitis in 62 of the 66 patients. However the remaining 4 cases with appendicitis were missed by USG. USG had a sensitivity of 93.93%, specificity of 100%, PPV of 100%, NPV of 89.47% and an overall accuracy of 96% in the diagnosis of acute appendicitis. USG is thus a sensitive and specific imaging modality in the diagnostic work up of patients with right iliac fossa pain. USG may improve the diagnostic accuracy in patients with suspected acute appendicitis.

**Key words:** Clinical examination, USG, acute appendicitis.

### Introduction

In 1554, French physician Jean Fernel first described the term acute typhilitis (derived from the Greek typhlon for caecum) and perityphilitis. Reginald Fitz, professor of pathology, published a landmark manuscript describing the appendix as the source of inflammation in acute typhilitis. It is Fitz who first coined the term appendicitis.<sup>1</sup> In

1889, Charles McBurney published his experience with many successful operations for early removal of the appendix. He also described the point of maximum tenderness in acute appendicitis, now famous, as McBurney's point.<sup>1</sup>

Acute appendicitis is the most common abdominal surgical emergency.<sup>2</sup> Between 5 and 10 % of the population develop this condition at sometime in life. The peak incidence is in the second and third decade of life, but can occur at any age.<sup>3</sup>

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Despite technological advances, the diagnosis of appendicitis is still based primarily on the patient's history and physical examination. Although no single aspect of the clinical presentation accurately predicts the presence of appendicitis, a combination of various signs and symptoms may support the diagnosis. The three signs and symptoms that are most predictive of acute appendicitis are pain in the right iliac fossa, abdominal rigidity and migration of pain from periumbilical region to the right iliac fossa.<sup>4</sup> It is believed that in 80% of cases diagnosis can be made clinically but the remaining 20% have atypical presentations and pose a diagnostic challenge.<sup>5</sup>

Ultrasonography (USG) came as a specific tool for preoperative diagnosis of acute appendicitis in 1981 when Deutsch and Leopold reported the visualization of an inflamed appendix for the first time in a young leukemic patient.<sup>6</sup> Puylaert in 1986 first introduced the graded compression technique for the diagnosis of acute appendicitis.<sup>7</sup> In this technique, the probe is applied with gradually increasing pressure over the right iliac fossa to displace the bowel loops and visualize the appendix.

## **Materials and methods**

All patients who presented to the emergency department with acute abdomen were examined preliminarily by the surgeon. Based on the patient's symptoms (anorexia, nausea, vomiting, site and migration of pain) and signs (tenderness in right iliac fossa, rebound tenderness, Mc Burney's sign, cough sign, Rovsing's sign) a clinical diagnosis of acute appendicitis was made and then patient was referred for USG examination.

In all cases the abdominal organs were first scanned followed by examination of the right iliac fossa using the graded compression technique. The diagnosis of acute appendicitis was suggested by the presence of an aperistaltic, non-compressible tubular structure arising from the caecum with target appearance on transverse section. The maximum outer diameter of > 6 mm and a wall thickness > 3 mm were considered diagnostic for acute appendicitis. USG was considered negative for appendicitis when the appendix could not be visualized or if other pathology was discovered for the cause of pain in the right iliac fossa.

Patients underwent appendicectomy on the basis of the surgeon's final clinical impression after USG examination. Histopathological examination of the appendectomy specimen was done using routine hematoxylin and eosin staining. The histopathological diagnosis was considered as the gold standard for the diagnosis of acute appendicitis.

After completion of the study, data collected were compiled with Excel (version 5.0) and were further analyzed by SPSS (version 10.0). Appropriate statistical tools were used to find out the significance of the variables.

## **Observation and results**

100 patients (54 male, 46 female) with a clinical diagnosis of acute appendicitis were subjected for USG examination. Seventy-four patients (74 %) underwent appendicectomy. Histopathological examinations of the appendectomy specimens showed acutely inflamed appendix in 44, gangrenous appendicitis in 5, gangrenous

appendicitis with perforation in 17 and a normal appendix in 8. Thus, histopathological examination confirmed acute appendicitis in 66 patients, while 8 operated appendixes were normal. In the remaining

26 patients, the surgeon's initial clinical impressions were altered and appendectomy avoided after USG examination (**Table 1**). Clinical examination thus had a sensitivity and PPV of 66% in the diagnosis of acute appendicitis.

**Table 1: USG findings in patients who did not have appendicitis (n = 26)**

	No. of cases discharged from emergency (n=14)	No. of cases admitted to ward (n=12)
Right nephrolithiasis	10	1
Normal abdominal scan (2 pregnant women)	-	3
Acute-calculus cholecystitis	-	2
Thickened bowel loops (?typhilitis)	-	2
Mesenteric adenitis	2	-
Rt. ovarian pathology	1	1
PID	1	-
Psoas abscess	-	1
Choledochal cyst with pancreatitis	-	1
Parietal wall abscess	-	1

Out of the 66 patients who had histopathologically proven acute appendicitis, 62 (93.93%) were diagnosed on preoperative USG. In the remaining 4 (6.06%) patients USG missed the diagnosis. Of these 4 patients, two had perforated appendix, while one was an obese patient and the appendix could not be located, and the other had a malrotated gut with undescended caecum. Therefore in the present study, USG had a sensitivity of 93.93%, specificity of 100%, PPV of 100%, NPV of 89.47%, and an overall accuracy of 96% (p < .0001). **Table 2** shows the comparative efficacy of USG and clinical examination in the diagnosis of acute appendicitis. Of the 26 patients whose initial clinical diagnosis of appendicitis was altered after USG, 21 (80.76%) were female and 5 (19.23%) were male. The rate of clinical misdiagnosis of acute appendicitis was thus higher in female than in male patients.

As mentioned, 8 patients were operated for acute appendicitis even though USG was negative for appendicitis. The USG

findings in these 8 patients were normal scan in 5, right nephrolithiasis in 1, pregnancy with right hydronephrosis in 1 and mesenteric adenitis in 1. Five (62.5%) of these cases were females and 3 (37.5%) were males. Negative laparotomy for acute appendicitis was also higher in females.

**Table 3** shows the statistical analysis of the common presenting symptoms in patients with acute appendicitis. As shown in the table, the most significant symptom was pain migration (p<.0001) i.e. epigastric / periumbilical pain shifting to right iliac fossa, followed by localized pain (right iliac fossa or periumbilical) with p value <.0005.

**Table 4** shows the statistical analysis of the common clinical signs elicited in patients with acute appendicitis. As shown all the signs were statistically significant with cough sign, rebound tenderness and Rovsing's sign attaining p value of <.0001. This emphasizes the importance of clinical examination in patients with acute appendicitis.

**Table 2: Comparative efficacy of USG and clinical examination in diagnosis of appendicitis**

	No Appendicitis	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy X <sup>2</sup>	X <sup>2</sup> Value /Corrected P value
<b>Clinical</b>							
Yes	66	-	-	66	-	-	-
No	34	66	-	-	-	-	-
<b>USG</b>							
Yes	624	93.93	100	100	89.47	96	-
No	-34	-	-	-	-	-	<0.0001

**Table 3: Common symptoms of acute appendicitis**

	Appendicitis (n=66)	No Appendicitis (n=34)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy X <sup>2</sup>	X <sup>2</sup> Value / Corrected P value
<b>Pain</b>								
Yes	66	27	100	20.58	70.96	100	73	-
No	-	7	-	-	-	-	-	<0.0005
<b>Anorexia</b>								
Yes	42	13	63.63	61.76	76.36	46.66	63	5.85
No	24	21	-	-	-	-	-	<0.02
<b>Nausea</b>								
Yes	39	16	59.09	47.05	68.42	37.20	55	0.35
No	27	16	-	-	-	-	-	NS
<b>Vomiting</b>								
Yes	39	17	59.09	50	69.64	38.63	56	0.75
No	27	17	-	-	-	-	-	NS
<b>Pain migration</b>								
Yes	40	4	60.60	88.23	90.90	53.57	70	21.72
No	26	30	-	-	-	-	-	<0.001
<b>Fever</b>								
Yes	23	6	34.84	82.35	79.31	39.43	51	3.22
No	43	28	-	-	-	-	-	NS

**Table 4: Common signs of acute appendicitis**

Appendicitis (n=66)		No Appendicitis (n=34)	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy X <sup>2</sup>	X <sup>2</sup> Value / Corrected P value	
<b>Cough sign</b>									
Yes	64	12	96.96	64.70	84.21	91.66	86	43.48	<0.001
No	2	22							
<b>RIF tenderness</b>									
Yes	61	23	92.42	32.35	72.62	68.75	72	10.25	<0.005
No	5	11							
<b>Mc.Burney's sign</b>									
Yes	61	23	92.42	32.35	72.62	68.75	72	10.25	<0.005
No	5	11							
<b>Rebound tenderness</b>									
Yes	64	11	96.96	67.64	85.33	92	87	46.58	<0.0001
No	2	23							
<b>Rovsing's sign</b>									
Yes	43	2	65.15	94.11	95.55	58.18	75	29.50	<0.0001
No	23	32							

**Discussion**

Acute appendicitis is a common, frequently atypical and on going challenging clinical diagnosis. Despite major technological advances, history taking and clinical examination is still the primary step in the work up of patients with right iliac fossa pain.

In this study, there were three statistically significant symptoms viz pain, either in the right iliac fossa (92.42%) or periumbilical (7.57%) was

present in all patients (p<. 0005). Pain migration (initial epigastric or periumbilical pain shifting to right iliac fossa) was the most reliable symptom of appendicitis in this study (p<. 0001). Anorexia was a less valuable symptom (p<. 02). This contrasted with the findings by Berry J Jr et al,<sup>8</sup> where anorexia was the only and the most reliable symptom in their patients with appendicitis (p=. 005). Abdominal pain was also universal in their study. Nausea, vomiting and fever were unreliable symptoms in both this and Berry's studies. Rebound tenderness

in right iliac fossa, cough sign and Rovsing's sign were found to be significant ( $p < .0001$ ) signs of appendicitis in the present study. This finding substantiates the importance of careful clinical examination in diagnosing acute appendicitis.

In a similar comparative study by Chen SC et al<sup>9</sup>, the use of USG in the diagnosis of acute appendicitis had a sensitivity of 96%, specificity of 67.6%, a PPV of 89.8%, a NPV of 86.2%, and an accuracy of 89.1%. The surgeon's clinical diagnosis without USG had a sensitivity of 86.2%, a specificity of 37.0%, a PPV of 74.6%, a NPV of 55.6%, and an accuracy of 70.6%. The overall accuracy of USG in the diagnosis of acute appendicitis was superior to that of the surgeon's clinical impression.

In another study by Manner M and Stickel W<sup>10</sup>, USG showed significantly higher sensitivity (95 vs. 45%) and specificity (100% vs. 75%) in confirming as well as ruling out appendicitis. USG in addition showed other diagnosis that mimic acute appendicitis. The authors too concluded that USG is a valuable tool in confirming as well as ruling out acute appendicitis.

The rate of misdiagnosing appendicitis (21 of the 26 patients) and negative appendectomy (5 of the 8 negative appendectomies) were both higher in females than male in the present study. This finding is in agreement with the findings of Addiss DG et al.<sup>11</sup> The rate of negative appendectomy among females in the reproductive age group was 2.5 times higher than that for males. The overall diagnostic accuracy was also lower for females than males

(78.6% vs. 91.2%). One of the reasons could be the frequent gynecological condition that can mimic acute appendicitis.

Acute appendicitis is probably the only surgical disease where a diagnostic accuracy of only 70 to 75% is accepted.<sup>12</sup> In the present study clinical examination had a sensitivity and PPV of 66%. USG achieved a better statistical result than clinical examination in the diagnosis of acute appendicitis. Hence preoperative USG should be routinely done to confirm or rule out appendicitis and to diagnose other pathological conditions mimicking acute appendicitis.

### **In conclusions**

1. USG is a sensitive and specific imaging modality in the diagnostic work up of patients with right iliac fossa pain. USG may improve the diagnostic accuracy in patients with suspected acute appendicitis. Women suspected of having appendicitis would benefit the most from pre-operative USG.
2. Clinical findings and experience is of paramount importance in diagnosing acute appendicitis. If clinical suspicion is high, negative USG should not withhold the surgeon from performing an operative intervention.

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