The Benefit of Routine Abdominal Echo for Acute Abdominal Pain of the Right Lower Quadrant with Suggested Appendicitis

CHAO-TE LEE1,6, WEI-KUNG CHEN2, SHIUMN-JEN LIAW3, WEI-BER LIAO4, CHIA-SHENG CHANG5, TSUNG-HSING LIN1

Background: Acute abdominal pain with equivocal clinical examination is still a great challenge for emergency physicians. The aim of this study was to determine whether routine abdominal echo is helpful in the differential diagnosis for acute abdominal pain of the right lower quadrant (RLQ) with or without typical symptoms and signs of appendicitis in the emergency department.

Methods: A total of 55 adult patients with suggested appendicitis underwent ultrasonography of the RLQ. Patients with symptoms and signs of appendicitis (migratory pain, localized and rebounding tenderness over McBurney's point, and leukocytosis with left shift, and plain abdominal radiography showing ileus located in the RLQ or appendiceal fecalith) were defined as typical; the other patients admitted had equivocal signs and symptoms of acute appendicitis which were atypical. Pediatric patients (age was less than 15 years old) and pregnant patients were not included in this study. Patients without complete examination results were excluded from our study. Thirty-five patients had typical symptoms and signs of appendicitis; 20 patients presented with equivocal symptoms and signs of appendicitis. The SPSS statistical programs packages were used for the statistical analysis. Differences were regarded as statistically significant when p<0.05.

Results: Thirty-five patients had typical symptoms and signs of appendicitis. Thirty-one of the 35 patients had positive signs on ultrasonography. Twenty patients did not have typical symptoms and signs of appendicitis and they were individually analyzed: three patients had right side hydronephrosis, three had gynecological problems (endometriosis, ovarian cyst rupture, and ovarian cyst torsion), two had dilated blind-end loop with target images, as well as appendicitis proven by appendectomy, and one had a cecal tumor. The ultrasonographic findings of the remaining patients (11 patients) showed normal images or much bowel gas, and four of them underwent surgery for appendicitis. The use of abdominal echo alone was of limited benefit in detecting true appendicitis in patients with atypical symptoms and signs of appendicitis (p>0.05). However, it was a valuable tool in performing differential diagnosis.

Conclusion: Routine abdominal echo performed by gastroenterologists or trained physicians is a useful tool in the differential diagnosis of patients with acute pain of the RLQ and without typical symptoms and signs of appendicitis.

Key words: right lower quadrant, appendicitis, routine abdominal echo
Introduction

Abdominal pain of the right lower quadrant (RLQ) is probably one of the most challenging problems that emergency doctors must face due to the wide range of possible surgical and non-surgical diagnoses\(^{(1)}\). Nonspecific clinical presentation, a long list of possible laboratory examinations as well as gender and age factors, makes diagnosis particularly difficult. Delayed diagnosis of acute appendicitis is associated with an increased rate of perforation, increased surgical complications, higher medical expenses and sometimes more legal problems\(^{(2)}\).

Acute abdominal pain over the RLQ is a major cause of admission to surgical units. In most patients, acute appendicitis is diagnosed on the results of clinical examination, white blood cell (WBC) count, and plain abdominal radiography. However, in industrialized countries these findings of these indicators result in false appendicitis rates of 15% to 30%\(^{(3)}\). Some authors have recommended the routine use of computed tomography (CT) scans for patients with acute RLQ pain who are suggested of having acute appendicitis in order to improve care and to reduce the use of hospital resources for patients\(^{(2,4,5)}\). However, some researchers have shown that higher costs of preoperative abdominal CT scanning may restrict availability\(^{(2,4,6)}\). A patient who presents with acute abdominal pain that has migrated from the umbilicus to the RLQ and is associated with peritoneal sign over the McBurney’s point, combined with leukocytosis should always be taken directly to the operating room for surgical intervention\(^{(1,6,7)}\). When the clinical presentation is equivocal, diagnostic imaging can be used to improve diagnostic accuracy and decrease the rate of false appendicitis.

The aim of this study was to determine whether routine abdominal echo was helpful in performing a differential diagnosis for acute abdominal pain of the right lower quadrant with suggested appendicitis in the emergency department (ED).

Materials and Methods

A total of 55 adult (age was equal or greater than 15 years old) patients with clinically suggested appendicitis due to acute pain over the RLQ, and without trauma or pregnancy, underwent ultrasonography (US) in an emergency room from August 8, 2002 through February 8, 2003. Patients without complete study results were excluded. Prospective analyses of the 55 patients were conducted and appendectomies were recommended by a consultant surgeon in the emergency setting. These patients were divided into two groups. Patients who had migratory pain with rebounding tenderness over the McBurney’s point, leukocytosis and left shift, and plain abdominal radiography showing ileus located in the RLQ or appendiceal fecalith were defined as having typical symptoms and signs of appendicitis; the other patients with equivocal symptoms and signs of appendicitis were classified as atypical. Abdominal sonography screening was performed by gastroenterologists or emergency physicians on all of the clinically suggested cases. The emergency physicians should be members of the Society of Ultrasound and have experience with sonographic diagnoses of acute appendicitis. The establishment of the diagnosis of positive sonographic findings for acute appendicitis is based on the combination of a positive sonographic McBurney’s sign, blind-ending tubules structure greater than 6 mm in outer diameter and non-compressibility of the appendix with the periappendiceal free of gas or abscess\(^{(7,8)}\). The results of sonographic examination were discussed with the consultant surgeons. Patients with typical symptoms and signs of appendicitis and positive sonographic findings of acute appendicitis underwent surgery. Those with
other diseases were treated for their conditions after consulting sub-specialist. The equivocal cases with negative sonographic findings were observed for at least 6 hours in the ED or abdominal CT was arranged. The patients with normal screenings and without operations were discharged from the hospital and were followed up for 1 week. The diagnosis of true appendicitis was confirmed by the pathologic findings. The SPSS statistical programs packages were used for the statistical analyses. Categorical variables were compared between the two groups using $\chi^2$ test or Fisher exact test. Differences were regarded as statistically significant when $p$ value was less than 0.05.

**Results**

A complete study was obtained for each of the 55 adult patients, which included 31 men and 24 women. The patients’ mean age (SD) was 33 (13) years old (range, 15-70 years old). Thirty-five patients had the typical symptoms and signs of appendicitis: 31 of the 35 patients had results positive for appendicitis on ultrasonography and four patients did not. The appendix could not be found due to central obesity or intestinal gas in the four patients. They all underwent surgery. Except for one patient (had positive ultrasonography for appendicitis, but cecal diverticulitis was proven after surgery), 34 patients had acute appendicitis which was confirmed by pathology. On the other hand, 20 patients (including 11 men and 9 women) had equivocal symptoms and signs of appendicitis (Table 1). The various diagnoses after ultrasonography for the 20 patients are shown in Figure 1. They included: (1) a ureteral calculus with hydronephrosis and obstruction that was later confirmed by intravenous pyelography (n=3, 3/20=15%); (2) gynecological problems: endometriosis, corpus luteum rupture, and ovarian cyst torsion (Figure 2) (n=3, 3/20=15%); (3) cecal tumor (Figure 3) (n=1, 1/20=5%); (4) dilated blind-end loop with a target imaging measuring more than 6mm on the cut section, and the confirmation of diagnosis of appendicitis was histological (Figure 4) (n=2, 2/20=10%); and (5) in the remaining 11 cases, the findings of echography showed excess bowel gas or no specific images. Four cases had persisting RLQ pain and elevation of the WBC count (1 had positive findings of appendicitis by CT and 3 had more than 6 hours observed in the emergency setting). They underwent laparotomy. Appendicitis was confirmed by a pathologist’s examination of the removed appendix (n=4, 20%). Seven cases improved with conservative management. They were followed up for 1 week after discharge. No case of acute appendicitis was noted during this time (n=7, 7/20=35%). Finally, six patients underwent appendectomy (only 2 cases had positive echo findings). The three cases who had urolithiasis were scheduled to receive extracorporeal shockwave lithotripsy (2 cases) and ureteroscopic lithotripsy (1 case). The case with ovarian cyst torsion underwent laparoscopic oophorectomy. Owing to stable vital signs, the case with corpus luteum rupture was observed in the hospital ward and discharged 2 days after admission. One patient had a cecal tumor. He underwent surgery (right

<table>
<thead>
<tr>
<th>Table 1</th>
<th>The demographic data of the patients with suspected appendicitis</th>
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<tr>
<td></td>
<td>male</td>
</tr>
<tr>
<td>with typical s/s</td>
<td>20</td>
</tr>
<tr>
<td>equivocal s/s</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>31</td>
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s/s: symptoms and signs
Fig. 1 The evolution of diagnoses in patients after ultrasonography

Discussion

Ultrasonography is a helpful tool in the diagnosis of some diseases. It can be used easily by physicians in the emergency setting. Acute appendicitis is the most common condition with RLQ pain that requires emergency abdominal survey. In recent years, ultrasonography has achieved an important place in the diagnosed of acute appendicitis. US has the highest diagnostic reliability for acute appendicitis in children (77.7% sensitivity and 94.8% specificity) compared with other techniques\(^{(4,8,11)}\). In adult patients, the sensitivity of US is 75~90%. The corresponding specificity is 73~98%. The accuracy is between

hemicolecotomy and end to end anastomosis) due to ischemic bowel changes. The pathology showed adenocarcinoma. The outcome of this patient was very poor. In our study, the sensitivity of US to find true appendicitis was 80%. The specificity was 93%. The positive and negative predictive values were 96.9% and 63.6%, respectively. The accuracy was 83.6% (Table 2).
76\% and 96\%. The positive and negative predictive values are about 92\% and 63\%, respectively\,(2,7,8,10). In some studies, the blind-ending tubules structure greater than 7mm or more suggested the diagnosis of appendicitis. This would increase the specificity\,(2,7). However, some patients had acute appendicitis in spite of a diameter of the appendix of 6mm, we used these criteria in our study\,(8). A patient who presents with typical symptoms and signs of acute appendicitis should be arranged to the operating room for surgical intervention. Delaying the treatment would result in perforation of the appendix in cases of acute appendicitis within 24 to 48 hours\,(2,8). In adult patients with true appendicitis, US may help give assurance (the specificity of US to find the true appendicitis
was 93% in our study). US also provided the exact point tenderness on the appendix, so the surgeon was able to incise the skin more precisely. In patients without typical symptoms and signs of acute appendicitis further investigation is needed. For the physician it is a considerable challenge to differentiate among a wide variety of conditions that may give rise to acute pain in the RLQ. The most important components of differential diagnoses are the patient’s history and physical examination results. Sonography is a useful differential diagnostic modality which makes it possible to visualize diseases which clinically imitate appendicitis\(^9\). If US is used routinely in patients with acute RLQ pain, accuracy of diagnosing acute pain in the RLQ may be improved and rates of unnecessary appendectomy may be reduced. In many institutions, computed tomography is used to diagnose diseases in patients with acute RLQ pain. The advantages of CT are its operator independency with resultant higher diagnostic accuracy and enhanced delineation of disease extent. With improvements in CT, including multislice spiral CT, the entire abdomen can be scanned at a high resolution in thin slices during a single period of breath-holding. For patients with suggested appendicitis, spiral CT has a sensitivity of 90 to 100%, a specificity of 91 to 99%, a positive

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Table 2 Results of sonography

<table>
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<tr>
<th>Sonographic diagnosis</th>
<th>True appendicitis (proved by pathology)</th>
<th>Non-appendicitis</th>
</tr>
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<tbody>
<tr>
<td>Appendicitis</td>
<td>32</td>
<td>1</td>
</tr>
<tr>
<td>Non-appendicitis</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>15</td>
</tr>
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Sensitivity 80%; specificity 93%; positive predictive value 96.9%; negative predictive value 63.6%
predictive value of 95 to 97%, and an accuracy of 94 to 100% (10). US and CT are the imaging methods of choice for the examination of patients with RLQ pain. The obvious advantages of US compared with CT are its lower cost, higher speed, noninvasiveness, imaging in real-time, lack of ionizing radiation, and ability to precisely delineate gynecologic diseases (11). In our study, US was the first choice to evaluate the patients with suggested appendicitis, especially the equivocal patients without typical symptoms and signs of appendicitis. Patients presented with equivocal symptoms and signs of appendicitis and appendix cannot be seen by sonography. Helical CT may be arranged to clarify the diagnosis at the next step. In addition, diagnostic laparoscopy has been advocated to clarify the diagnosis in equivocal cases. However, it is an invasive procedure with an approximate 5% rate of complications, which in most cases were associated with the use of general anesthesia (10,13). Abdominal echo was of little help in diagnosing patients with true appendicitis without typical symptoms and signs of appendicitis in our study. Nevertheless, it was a valuable tool in performing differential diagnoses for patients with acute pain in the RLQ. In our prospective study, US changed the suggested diagnostic and therapeutic options in 35% of the patients without typical symptoms and signs of appendicitis (n=7). Generally speaking, the patients with classic presentations of appendicitis should always undergo surgical intervention. For the patients with equivocal clinical presentations, the use of carefully performed routine abdominal echo is necessary. The cases without specific findings on US may need to undergo spiral CT with contrast material or be observed for more than 6 hours in order to clarify the diagnosis.

Conclusion

The history and physical examination results remain the diagnostic cornerstone in evaluating patients with pain in the right lower quadrant. For patients with RLQ pain, abdominal echo should always be performed as a routine measure. Ultrasonography is a useful tool in the differential diagnoses of acute pain in the RLQ in the emergency setting. Nevertheless, extensive large-scale surveys are warranted and should be encouraged in future studies.

References

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急性右下腹痛且懷疑闊尾炎患者
使用例行性腹部超音波檢查之研究

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急診醫師常會遇到右下腹痛患者，這些患者有些會表現出典型之急性闊尾炎症候（上腹至右下腹之轉移痛，顆粒球性白血球上升，及腹膜炎徵候），有些則不明顯。本研究之目的為例行性使用腹部超音波檢查，於急性右下腹痛患者且懷疑闊尾炎患者，並篩選不具典型症候之急性闊尾炎患者，做鑑別診斷：

共有55位患者因急性右下腹痛至急診就醫，於第一線急診醫師及會診醫師，懷疑是急性闊尾炎的情況下，安排例行性腹部超音波檢查，有35位患者有典型之急性闊尾炎症候，其中有31位患者，其腹部超音波有闊尾炎影像；另外20位患者有非典型之急性闊尾炎症候，其腹部超音波檢查，有特別發現的案例有9件(佔45%)：3例是泌尿科疾病，3例是婦產科疾病，1例是盲腸腫瘤，2例有明顯闊尾炎變化)，於20個案例中，最後有6例經手術後，證實為急性闊尾炎，故例行性使用腹部超音波來診斷不具典型症候之急性闊尾炎，其診斷價值有限，但作為鑑別診斷時，則有其必要性。

關鍵詞：急性右下腹痛，闊尾炎，例行性腹部超音波

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