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Diagnostic Value of Ultrasonography in Appendicitis

Wartość diagnostyczna ultrasonografii w zapaleniu wyrostka robaczkowego

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Abstract

Background. Clinical diagnosis of appendicitis is often difficult in atypical patients.

Objectives. The authors aim to determine the diagnostic accuracy of ultrasonography (US) for acute appendicitis.

Material and Methods. 121 consecutive patients with right lower abdomen pain were evaluated. Of them, 25 were excluded due to not having performed a preoperative US and 5 were obese (Body Mass Index > 30). A total of 91 patients were evaluated. The patients were assessed clinically and radiologically. Blood and urine analysis was carried out in all patients. US was performed with a Toshiba Fomio 8 brand machine with 3.75 and 8 MHz linear probes. Patients underwent an operation and an appendectomy was done. Specimens were sent for histopathology to confirm appendicitis.

Results. Ultrasound supported the diagnosis of acute appendicitis in 58 (63.7%) patients. In the US with positive findings, 55 patients (94.8%) had inflamed appendices on histopathology and 5 (8.6%) had normal appendices. The overall sensitivity of ultrasonography was 71.4% and specificity was 78.5%. Positive predictive value (PPV), negative predictive value (NPV) and the diagnostic accuracy of ultrasonography are 94.8%, 33.3%, and 72.5% respectively.

Conclusions. All diagnostic tests are adjunctive to the clinician. US should be the first step in the care of patients with right lower abdominal pain after the physical examination (*Adv Clin Exp Med* 2012, 21, 5, 633–636).

Key words: appendectomy, accuracy, ultrasound.

Streszczenie

Wprowadzenie. Kliniczne rozpoznanie zapalenia wyrostka robaczkowego u nietypowych pacjentów często jest trudne.

Cel pracy. Autorzy mają na celu określenie trafności diagnostycznej ultrasonografii (USG) w ostrym zapaleniu wyrostka robaczkowego.

Materiał i metody. Zbadano 121 kolejnych pacjentów, u których wystąpił ból w dolnym prawym kwadrancie brzucha. Wśród nich wyłączono 25 osób, ponieważ nie wykonano przedoperacyjnego USG, oraz 5 osób otyłych (wskaźnik masy ciała > 30). Łącznie zbadano 91 pacjentów. Pacjentów oceniono klinicznie i radiologicznie. Analizę moczu i krwi przeprowadzono u wszystkich. USG wykonano za pomocą aparatu Toshiba Fomio 8 z sondami linowymi o częstotliwości 3,75 MHz. Pacjentów operowano i wyrostek robaczkowy został wycięty. Próbkę wysłano na badania histopatologiczne w celu potwierdzenia rozpoznania zapalenia wyrostka robaczkowego.

Wyniki. Badanie ultrasonograficzne potwierdziło rozpoznanie ostrego zapalenia wyrostka robaczkowego u 58 (63,7%) chorych. Wśród chorych, u których badanie USG dało wynik dodatni u 55 pacjentów (94,8%) stwierdzono histopatologicznie, że wyrostek robaczkowy był objęty procesem zapalnym, a u 5 (8,6%) wyrostek robaczkowy miał budowę prawidłową. Ogólna czułość ultrasonografii wyniosła 71,4%, a swoistość 78,5%. Wartość predykcyjna wyniku dodatniego (PPV), wartość predykcyjna wyniku ujemnego (NPV) i dokładność diagnostyczna ultrasonografii to odpowiednio: 94,8; 33,3 i 72,5%.

Wnioski. Wszystkie testy diagnostyczne są pomocą dla lekarza. Badanie USG powinno być pierwszym krokiem, po badaniu fizykalnym, w leczeniu pacjentów, u których wystąpił ból w dolnym prawym kwadrancie brzucha (*Adv Clin Exp Med* 2012, 21, 5, 633–636).

Słowa kluczowe: wycięcie wyrostka robaczkowego, dokładność, ultradźwięki.

Acute appendicitis is one of the most frequent causes of acute abdomen pain [1]. Despite physical examinations, laboratory tests and imaging techniques, it may be misdiagnosed with other diseases. There is no accurate imaging method that diagnoses preoperative appendicitis. In patients with typical appendicitis, it is easy to diagnose. Symptoms, such as location of pain, loss of appetite, nausea, vomiting, tenderness, fever and leukocytosis, are precise criteria for the diagnosis of appendicitis. However, 20–33% of patients have atypical clinical and laboratory findings [2, 3]. In these patients, scoring systems, ultrasonography (US), computed tomography (CT), magnetic resonance (MRI) and laparoscopy can be used. US is the first step with atypical patients. The advantages of US are that it is cost-effective and easy to perform. On the other hand, individual experience is the disadvantage of US. Despite the diagnostic modalities, among children, adults, pregnant and elderly patients diagnosis is still difficult and perforation and negative appendectomy rates remain high [4, 5]. The aim of this study is to evaluate the role of ultrasonography in the diagnosis of acute appendicitis.

Material and Methods

The authors retrospectively analyzed the medical records of 121 consecutive patients who underwent an appendectomy at Tepecik Training and Research Hospital from June 2008 to January 2010. Of them, 25 were excluded due to not performing a preoperative US and 5 were obese. A total of 91 patients were operated because of a suspected acute appendicitis. There were 47 female and 44 male patients with a mean age of 30.6 years. US findings were compared to histopathology reports. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy of ultrasonography for appendicitis were calculated.

US was performed with Toshiba Fomio 8 brand machine with 3.75 and 8 MHz linear probes using the Puylaert's gradual press technique. US diagnosis of appendicitis was based on identifying a non-compressible, blind-ended tubular structure in the right lower quadrant with sonographic features indicating intestinal origin greater than 6 mm. Periappendiceal inflammatory change in the ab-

sence of a visualized abnormal appendix were not considered specific for acute appendicitis.

Data was analyzed using SPSS version 15.0. Descriptive statistics were applied to calculate specificity, sensitivity, PPV, NPV and diagnostic accuracy. *P* values of less than 0.05 were considered to indicate a significant difference.

Results

There were 47 female and 44 male patients with a mean age of 30.6 (18–54) years. All the patients were examined by US. Acute appendicitis was diagnosed histopathologically in 77 of the 91 patients who were operated for appendicitis. There were 58 (63.7%) patients diagnosed preoperatively by US for acute appendicitis. Of them, there were 55 (94.8%) (true positive – TP) patients diagnosed appendicitis on histopathology and 3 (5.2%) (false positive – FP) patients diagnosed normal appendices. Thirty-three patients were ultrasound negative, of them 22 (66.6%) (false negative – FN) were diagnosed appendicitis on histopathology and 11 (33.4%) (true negative – TN) were normal appendices. Sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasonography are 71.4%, 78.5%, 94.8%, 33.3%, 72.5% respectively (Table 1).

Table 1. Ultrasonography characteristics

Tabela 1. Cechy badania USG

Results (Wyniki)	Ultrasonography (USG) %
Sensitivity (Czułość)	71.4
Specificity (Swoistość)	78.5
Positive predictive value (Wartość predykcyjna wyniku dodatniego)	94.8
Negative predictive value (Wartość predykcyjna wyniku ujemnego)	33.3
Diagnostic accuracy (Dokładność diagnostyczna)	72.5

Discussion

Acute appendicitis is the most common surgical emergency in children and adolescents and most commonly seen in females in their 2nd and 4th decades (90%) [1]. The negative appendectomy rate was 15% to 25%, but could be as high as 40% in female patients because many gynecological conditions, such as dysmenorrhea and ovarian cyst complications, can be misdiagnosed as acute appendicitis [4, 5].

Acute appendicitis may be misdiagnosed with other diseases despite physical examinations, laboratory tests and imaging techniques. Despite the diagnostic methods, among children, adults, pregnant and elderly patients diagnosis is still difficult and perforation and negative appendectomy rates remain high. Even experienced surgeons are unable to diagnose over 90%. There are 2 handicaps; if the diagnosis of appendicitis is more than 90%, more complications occur. On the other hand, a negative laparotomy may lead to morbidity as non-perforated appendectomy as [4, 5].

Despite all the clinical and diagnostic methods, negative appendectomy and perforation rates are 15–23%, 25%, respectively. The reason for this high rate is the increase of morbidity and mortality due to delaying diagnosis. If the diagnosis is delayed, perforation and associated morbidity and mortality increase [4, 5].

Negative laparotomy rates were high in females than males (35–45%, 10–15%, respectively) due to gynecologic diseases [6]. In present study, there were 14 (15.3%) negative laparotomies. Of them 10 (10.9%) were female and 4 (4.4%) were male. In 2 of 10 female patients, paratubal serous cyst and ruptured extrauterine pregnancy were detected. Female patients with abdominal pain must be evaluated carefully.

The diagnostic value of ultrasound is low in perforation and depends on the experience of the radiologist. Flum et al. reported 23.2% perforation rates in a retrospective study [7]. In the present study, there were 14 (15.3%) cases of perforation. Of them, 10 (10.9%) were male and 4 (4.4%) were female. Five were older than 40. There were 4 (4.3%) FN perforated appendicitis which ultrasound diagnosed as appendicitis. There were 10 (10.9%) true-positive perforated appendicitis which the ultrasound diagnosed. The authors think that the reasons for low rate are early application, frequent examination intervals and the operation occurring immediately after the diagnosis.

Karakas et al. reported 74% sensitivity, 94% specificity, 90% accuracy, 74% PPV and 94% NPV diagnostic performance of ultrasonography in ap-

pendicitis. Obesity, abdominal rigidity, retrocecal appendicitis, perforation and experience of radiologist are the cause of FN results [8]. In this study there were 1 hyperplastic polyp and 2 gynecologic disorders that were diagnosed as FN.

Since the use of ultrasonography in the diagnosis of appendicitis report by Puylaert in 1986, sensitivity, specificity, accuracy, PPV and NPV of ultrasonography in the diagnosis of appendicitis are reported 44–98%, 47–95%, 84–96% and 76–97%, respectively [9]. In present study; sensitivity, specificity, PPV, NPV and diagnostic accuracy of ultrasonography are 71.4%, 78.5%, 94.8%, 33.3%, 72.5% respectively. In this study NPV rates are low. It can be attributed to rates of TN.

Some authors revealed that US is valuable in (95% sensitivity, 94% specificity and diagnostic accuracy 96%) suspected acute appendicitis rather than clinically acute appendicitis. US must be the first step in treating such patients because it is cost effective, easy to access and perform. But diagnostic tests are adjunctive to the clinician. Physical examination is always the first step in the patients' evaluation. In obese and uncooperative patients sometimes US is unable to diagnose appendicitis. In such cases, CT or MRI can be useful. Of these, CT has become the favored diagnostic modality for the diagnosis of appendicitis. The preference for CT has been attributed to its technical reproducibility as well as its high sensitivity and specificity for diagnosis. The sensitivity and specificity of CT range between 87% and 100% and 89% and 99%, respectively [10]. Friday et al. reported that 2–3 million CT scans were performed annually, with a seven-fold increase [11].

In conclusion, clinical diagnosis of appendicitis is often difficult in atypical patients and atypical appendix. Concerning patients with typical presentation, history and physical examination, it is sufficient. However, in regards to approximately 35–45% of patients with atypical presentation imaging, it is most helpful [5]. In these groups, US is the first imaging technique. If US is accurate in the diagnosis, there is no need for further examination. CT scans should be used in US and clinically findings are non-diagnostic. If the US, CT scan and physical examination is not enough for an accurate diagnosis, patients may be observed with morbidity or undergo an operation with negative appendectomy. The authors think that US is an initial diagnostic modality in suspicious appendicitis after the physical examination. As shown in present results, US is not effective in the diagnosis of appendicitis. It is not a gold standard in the diagnosis of appendicitis. It should be performed as an adjunctive to the clinician.

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