Ann Colorectal Res. 2016 June; 4(2):e36712. doi: 10.17795/acr-36712.

Published online 2016 May 16. **Research Article**

Comparison of Preoperative Ultrasonography and Pathology Results of Patients Undergoing Appendectomy

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Received 2016 January 27; **Accepted** 2016 April 25.

Abstract

Background: It is still difficult to make the diagnosis of acute appendicitis in children with only clinical examination.
Objectives: The present study, retrospectively reviewing the data of the patients that underwent appendectomy, aimed at emphasizing the diagnostic value of ultrasonography findings by comparing them with pathological diagnosis.
Patients and Methods: This retrospective study included patients aged under 18, who were operated on for appendicitis between 1 January 2015 and 31 December 2015. The relationship between the pathology results of these patients and the results of preoperative ultrasonography performed for the diagnosis of acute appendicitis was investigated.
Results: The study included 100 patients, 42 were female and 58 were male, on whom ultrasonography was performed and whose mean age was 11.3 $\pm$ 3.7 years. While there were 28 (28%) patients who did not receive a definitive diagnosis of appendicitis pathologically, there were 43 (43%) patients in whom there were no ultrasonography findings supporting appendicitis. While appendicitis diagnosis was made pathologically in 72 patients (72%), suggestive findings of appendicitis, such as compression and double wall thickness of the appendix (over 6 mm), were detected in 57 patients (57%). In addition, 42% periappendiceal fluid collection, 25% periappendiceal fat inflammation, and 14% appendicolith were detected by ultrasonography. While 47 (65.3%) of the 72 patients with pathologically confirmed appendicitis received appendicitis diagnosis by ultrasonography, 25 (34.7%) did not (Pearson square test P = 0.007). The sensitivity and specificity of ultrasonography in the diagnosis of appendicitis were 66.6% (48/72) and 64.28% (18/28), respectively.
Conclusions: According to the results of the current study, ultrasonography, in the diagnosis of appendicitis, should only be used for the support of clinical diagnosis or for differential diagnosis.

Keywords: Ultrasonography, Appendicitis, Diagnosis, Children

1. Background

It is still difficult to make the diagnosis of acute appendicitis in children with only clinical examination. Children are usually incapable of verbalizing their symptoms, and findings of physical examination are nonspecific. Exploration and removal of a noninflamed appendix after an incorrect diagnosis of acute appendicitis (negative appendicectomy) is not uncommon (1). Indeed, the accuracy of diagnosis of acute appendicitis has been reported to be between 59% and 97%, with negative appendicectomy rates between 7% and 38%. The issue becomes more cumbersome in childhood with negative laparotomy rates reaching as high as 70% in children under three years of age and 50% in preschool age children. Furthermore, several previous studies indicate that a perforation rate for children is also high, ranging from 14% to 90% (2-4).

The accuracy of clinical diagnosis in patients with equivocal signs of appendicitis can be improved by abdominal ultrasonographic examinations.

2. Objectives

This study aimed at emphasizing the value of ultrasonography findings in the diagnosis of appendicitis by retrospectively reviewing the data of the patients on whom we performed appendectomy.

3. Patients and Methods

A retrospective clinical study was conducted in the Department of Pediatric Surgery, Gazi University Medical Faculty. This study included patients aged under 18, who were operated on for appendicitis between 1 January 2015 and

31 December 2015. The pathology results of these patients after appendectomy and the results of preoperative ultrasonography performed for the diagnosis of acute appendicitis were compared. While a double wall thickness of 6 mm and over was used for the diagnosis of appendicitis on ultrasonography, periappendiceal fluid collection, increase in periappendiceal fat inflammation, and appendicolith positivity were retrospectively examined. The relationship between the pathological results of the patients and ultrasonography findings was assessed.

Statistical calculations were performed in SPSS (version 21 for Windows, SPSS Inc., Chicago, Illinois, USA). P values less than 0.05 were considered significant.

4. Results

A total of 100 patients, 42 females and 58 males, whose ages ranged from 3 to 7 and mean age was 11.3 $\pm$ 3.7 years, and on whom ultrasonography was performed, were included into the study. While there were 28 (28%) patients who did not receive a definitive diagnosis of appendicitis pathologically, there were 43 (43%) patients in whom there were no ultrasonography findings supporting appendicitis. While appendicitis diagnosis was made pathologically in 72 patients (72%), suggestive findings of appendicitis, such as compression and double wall thickness of the appendix (over 6 mm), were detected in 57 patients (57%). In addition, 42% periappendiceal fluid collection, 25% periappendiceal fat inflammation, and 14% appendicolith were detected by ultrasonography. While 18 of the 28 cases that did not receive an appendicitis diagnosis pathologically did not have appendicitis on ultrasonography (64.3%), but 10 cases had appendicitis (35.7%) (Table 1). Moreover, while 47 (65.3%) of the 72 patients with pathologically confirmed appendicitis received appendicitis diagnosis by ultrasonography, 25 cases (34.7%) did not (P = 0.007). The sensitivity and specifity of ultrasonography in the diagnosis of appendicitis were 66.6% (48/72) and 64.28% (18/28), respectively. While ultrasonographic periappendiceal fluid collection was not present in 17 (60.7%) of the pathologically unconfirmed appendicitis cases but present in 11 (39.3%), free fluid was not present in 41 (56.9%) of the pathologically confirmed appendicitis cases but present in 31 (43.1%) (P = 0.732). While ultrasonographic view of periappendiceal fat inflammation was not present in 26 (92.9%) of the pathologically unconfirmed appendicitis cases but present in 2 (7.1%), it was not present in 49 (68.1%) of the pathologically confirmed appendicitis cases but present in 23 (31.9%) (P = 0.01). While ultrasonographic view of appendicolith was not present in 26 (92.9%) of the pathologically unconfirmed appendicitis cases but present in 2 (7.1%), it was not present in 60 (83.3%) of the pathologically confirmed appendicitis cases but present in 12 (16.7%) (P=0.218). It was found that while 13 (46.4%) were female and 15 (53.6%) were male of the 28 pathologically unconfirmed appendicitis cases; there were 29 (40.3%) female and 43 (59.7%) male among the pathologically confirmed appendicitis cases. The sensitivity and specifity of ultrasonography in the diagnosis of appendicitis were 66.6% (48/72) and 64.28% (18/28), respectively.

5. Discussion

Acute appendicitis remains the most common acute abdominal condition in children that requires operative intervention. The clinical diagnosis of appendicitis in children may be especially challenging due to the difficulties in obtaining an accurate history, numerous other childhood disorders that mimic appendicitis, and atypical presentations that often occur in younger children. In the past, a negative appendectomy rate of up to 15% to 25% was common and widely accepted as a necessary consequence of avoiding missed appendicitis (5). No reliable diagnostic method has been developed to confirm or exclude the diagnosis of AP prior to operation so far. Due to communication and examination difficulties in children, diagnosis of appendicitis in children is generally considered more difficult than adults. Not only are children more likely to have symptoms for a longer period of time before a correct diagnosis is established than are adults, but also are more likely to suffer from the complications of appendicitis (6, 7).

In a study of 37109 children, who underwent surgical exploration with the diagnosis of acute appendicitis, a negative exploration rate was found as 8.4% (8). Also, other publications in the literature have reported that a negative exploration rate for children less than 15 years old varies from 7.5% to 12%. This rate reaches as high as 57% for children less than 6 years old (9, 10). Our negative exploration rate was 28%, which is higher within the limits in the literature.

In order to reduce the rate of negative exploration, various sophisticated diagnostic techniques have been utilized. Recently, ultrasound has been proven effective in the diagnosis of acute AP. The reported sensitivity and specificity rates for ultrasound are 42% to 90% and greater than 90%, respectively (11). The accuracy of pediatric US in the literature varies from 44% to 94% and specificity from 47% to 95% (5). In our study, the sensitivity and specificity of ultrasonography were 66.6% and 64.28%, respectively. Furthermore, the incidence of negative laparotomy was 28% in our study, and the positivity of ultrasonography was below that of clinical examination by giving us 57% positive results. However, ultrasonography provided higher rates (64.3%) of findings that supported the diagnosis in

Table 1. Comparison of the Pathological Diagnosis and Ultrasonography Findings of the Cases Operated on for Appendicitis

Pathological Diagnosis	6mm > Appendix		Peri-Appendiceal Fluid collection		Peri-Appendiceal Fat Inflammation		Appendicolith	
	-	+	-	+	-	+	-	+
Appendicitis (-) (n = 28)	18 64,3%	10 35,7%	17 60,7%	11 39,3%	26 92,9%	2 7,1%	2626 92,9%	2 7,1%
Appendicitis (+) (n = 72)	25 34,7%	47 65,3%	41 56,9%	31 43,1%	49 68,1%	23 31,9%	60 83,3%	12 16,7%

cases that did not receive appendicitis diagnosis pathologically. Similarly, 47 of the pathologically confirmed cases of appendicitis had 65.3% supportive findings of appendicitis on ultrasonography. What was interesting in our study is that the association of the absence of appendicolith and periappendiceal fat inflammation and the absence of pathologically confirmed appendicitis was 92.9%. The relatively low rate of accuracy, specifity, and sensitivity of ultrasonography in our study could be attributed to the absence of clinical experience and the fact that the results were evaluated by a different radiology resident every day. Recently, CT has proven more effective in the diagnosis of acute AP. The reported sensitivity and specificity rates have risen up from 87.2% to 99% and 16% to 98%, respectively. Although CT is more accurate in diagnosing acute appendicitis, children are ten times more sensitive to radiation induced cancer than adults. Hall has estimated fatal cancer development risk of a child who had an abdominal helical CT in childhood to be 1 in 1,000 (12). Moreover, Miano et al. (13) have stated that abdominal CT does not positively affect the results in suspicion of appendicitis.

Clinical observation and frequent examination are still the most effective methods in the diagnosis of acute appendicitis. Ultrasonography must be assessed correlatively with clinical examination, and appendicitis not supported by ultrasonography must be considered more reliable in cases that are not clinically considered as appendicitis.

Footnote

Authors' Contribution: Ramazan Karabulut, Zafer Turkyilmaz, Kaan Sonmez, and Abdullah Can Basaklar operated the patients. Ramazan Karabulut, Zafer Turkyilmaz, and Kaan Sonmez wrote the article. Kıvanc Seref collected data. Aylar Poyraz is a pathologist. Suna Ozhan Oktar is a radiologist and Abdullah Can Basaklar is a guarantor.

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