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Original Article

Investigation of the characteristics differentiating complicated and non-complicated appendicitis: A prospective analysis

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Abstract

Aim: To investigate preoperative laboratory and clinical results and imaging methods in patients with complicated and non-complicated appendicitis.

Materials and Methods: A total of 141 patients aged over 16 years, who underwent surgery with the diagnosis of acute appendicitis, were included in the study. In patients diagnosed with acute appendicitis based on physical examination and laboratory findings, abdominal contrast-enhanced tomography was performed for confirmation and differential diagnosis. Age, gender, body temperature, complaint, duration of complaint, number of white blood cells, the largest diameter of appendicitis measured on computed tomography (CT), Alvarado score, and recurrent admission to any health institution with the same complaint were recorded. Intraoperative findings and pathology reports were evaluated to determine whether the appendicitis was complicated, and the cases were divided into two groups as complicated and non-complicated.

Results: Totally 141 patients were included in the study, 39 cases were classified as complicated and 102 cases as non-complicated appendicitis. There were more people with high fever in the complicated group (p=0.023). The median of largest appendicitis diameter measured on the CT was 8.5 (5.5-15) mm, and a significant difference was determined between the two groups in terms of diameter (p<0.001). The median time from the onset of the complaints to the emergency department presentation was 12 hours, and this duration was significantly longer in the complicated group (p<0.001). Analysis of receiver operating characteristic curves yielded the cutoff values of 8.35 mm for diameter (area under the curve [AUC]: 0.860; sensitivity: 87.2%; specificity: 63.7%), and 10.5 hours for time interval (AUC: 0.868; sensitivity: 97.4%; specificity: 64.7%) were found to be the best predictive values for the complicated acute appendicitis determination.

Conclusion: In patients diagnosed with acute appendicitis, necessary interventions should be immediately undertaken, especially in the presence of fever, increased appendicitis diameter, and delayed presentation to hospital.

Keywords: Antioxidant; disulphide; hearing loss; thiol; tinnitus

INTRODUCTION

Acute appendicitis is one of the most common causes of abdominal pain that requires emergency surgery, and the risk of developing this disease during human life is around 7-8%. The incidence is slightly higher in males than in females and is most commonly seen at aged 20-30 years of age (1). The pathophysiology of acute appendicitis has been described as increased secretion, stasis and bacterial load caused by a progressive inflammatory process after luminal obstruction (2,3). This may be in the form of simple appendicitis where inflammation is localized only to the appendix vermiformis or complicated appendicitis presenting with gangrene, abscess, and perforation. In the case of complicated appendicitis, wound infection and post-operative intestinal obstruction rate, length of stay, and medical expenses increase (4,5). Studies have shown that the perforation rate in acute appendicitis is around 10-25%. The time from the onset of abdominal pain to the operation, presence of comorbidities, such as diabetes, age, various laboratory tests, and intra-abdominal pressure can be listed as factors that cause perforation (6-8).

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In this prospective observational study, the demographic data and clinical, radiological and laboratory characteristics of the patients who underwent emergency surgery with the diagnosis of acute appendicitis were investigated to determine the factors that could predict complicated appendicitis.

MATERIAL and METHODS

Patients older than 16 years of age, who underwent surgery for acute appendicitis between March 2019 and November 2019, were included in the study. In patients diagnosed with acute appendicitis based on physical examination and laboratory findings, abdominal contrast-enhanced computed tomography (CT) was performed for confirmation and differential diagnosis (Multidetector row scanner, Mx 8000 IDT 16, Philips Medical Systems, Best, the Netherlands). Patients without CT images and those diagnosed by ultrasonography were excluded from the study. Appendectomy was performed in cases where surgery was decided upon. Patients who were admitted to the service with the diagnosis of acute appendicitis but did not undergo surgery and those that underwent another surgical procedure were excluded from the study.

The number of patients included in the study was 141. The age, gender, body temperature, complaints, duration of complaints, number of white blood cells (WBCs), the largest diameter of appendicitis detected on CT, Alvarado score, and the presence of recurrent presentation to any healthcare institution with the same complaint were recorded on prepared forms. Then, the medical files of these cases were examined from the hospital archive (epicrisis and pathology reports) to determine whether appendicitis was complicated. Non-complicated appendicitis was defined as localized appendicitis in which the inflammation findings had not spread to the surrounding structures. Complicated appendicitis was considered as the presence of gangrenous tissue or perforation with or without abscess formation (4). In accordance with these definitions, our cases were divided into two groups as complicated and non-complicated appendicitis. Then, the clinical and demographic characteristics of the patients in the two groups were compared, and statistical differences were investigated. Using these differences, the factors that could predict the complication of acute appendicitis were explored.

Ethics committee approval was obtained from the local ethics committee (Approval no: 2019/3-12). Informed consent was obtained from all patients included in the study or from their parents.

Statistical analysis

SPSS version 17 was used in the study. The suitability of the continuous data for normal distribution was determined by the Kolmogorov-Smirnov test. The normally distributed data were analyzed by Student's t-test and the data without normal distribution by the Mann-Whitney U-test. The chi-square test was used to compare qualitative data. Numerical data conforming to normal distribution were expressed as mean ± standard deviation, and non-normally distributed data as median (minimum-maximum) values. Categorical variables were given as numbers and percentages. The effect of multiple independent variables on the two groups was investigated using binary logistic regression. Odds ratio (OR), 95% confidence interval (CI) and coefficient B values of these data were also obtained. ROC analysis was done for significant quantitative data, cut-off values were determined for diameter of appendicitis and time interval. A p value of <0.05 was considered significant.

RESULTS

The study was completed with a total of 141 patients, of whom 71.6% were male, and the median age of all the participants was calculated as 27 (17-74) years. After the evaluation of the operative findings and pathology reports, 39 appendicitis cases were classified as complicated and 102 as non-complicated. There was no significant difference between the complicated and non-complicated groups in terms of age and gender (p=0.151 and 0.419, respectively). The initial complaint was abdominal pain in all patients, and the body temperature was 38 °C and above in 14 patients. When the two groups were examined, more people had fever in the complicated group (p=0.023). The mean leukocyte count of the patients was 15.414 ± 4.873, and there was no significant difference between the two groups in terms of the leukocyte count (p=0.491) (Table 1).

The median Alvarado score was 8 (3-10), and 78% of the patients had an Alvarado score of >6, with no significant difference between the two groups (p=0.068). The median value of the largest diameter of appendicitis measured on CT was 8.5 (5.5-15) mm. In addition, the appendicitis diameter was ≥10 mm in 48 cases, and there was a significant difference between the two groups (p < 0.001). The median time from the onset of complaints to emergency department presentation was 12 hours, and 25.5% of the patients presented to the emergency department 24 hours after their complaints started. This duration was significantly longer in the complicated group (p<0.001). The median duration of hospitalization was 2 days (1-26), and it was longer in the complicated group than in non-complicated patients (p < 0.001). Thirty-three patients presented to the emergency department for more than once with the same complaints, but no significant difference was observed between the two groups in terms of recurrent presentation (p=0.616) (Table 1).

In the binary logistic regression analysis of the factors differentiating complicated and non-complicated appendicitis, the largest measured diameter of appendicitis (p < 0.001; OR, 0.341) and the duration of complaints (p < 0.001; OR, 0.929) provided significant results (Table 2). Utilizing appendicitis diameter ≥8.35 mm as a predictor of complicated AA, the cutoff point had a sensitivity of 87.2% and a specificity of 63.7%. A cutoff value of 10.5 hours for the time between onset of complaints to ED presentation had a sensitivity of 97.4% and a specificity of only 64.7% (Figure 1).

Table 1. Characteristics of patients				
Variables	Study population (141, 100%)	Complicated (39, 27.7%)	Uncomplicated (102, 72.3%)	p value
Age	27(17-74)	22(17-74)	27(17-65)	0.151
Gender(male)	101(71.6%)	26(66.7%)	75(73.5%)	0.419
Fever(≥38˚C)	14(9.9%)	8(20.5%)	6(5.9%)	0.023
WBC(cell/mm3)	15.414±4.873	15.994 ± 6.785	15.193 ± 3.926	0.491
Alvarado score	8(3-10)	8(3-10)	8(4-10)	0.068
Alvarado score (>6 points)	110(78%)	33(84.6%)	77(75.5%)	0.242
Diameter of Appendicitis(mm)	8.5(5.5-15)	11(7-15)	8(5.5-12)	<0.001
Diameter of appendicitis (≥10mm)	48(34%)	27(69.2%)	21(20.6%)	<0.001
Duration of complaint (hours)	12(1-96)	26(9-96)	7(1-70)	<0.001
Duration of complaint (≥24hours)	36(25.5%)	23(59%)	13(12.7%)	<0.001
Hospitalization duration	2(1-26)	4(2-26)	2(1-4)	<0.001
Recurrent presentation	33(23.4%)	8(20.5%)	25(24.5%)	0.616
P< 0.05 is statistically significant; WBC: white blood cells; mm:millimeter.				

Table 2. Logistic regression analysis for predicting complicated appendicitis				
Variables	B	OR	95% CI	p value
Age	0.002	1.002	0,961-1.045	0.931
Gender	0.656	1.928	0.493-7.530	0.345
Fever	-1.463	0.231	0.027-1.953	0.179
WBC	0	1.000	1.000-1.000	0.587
Alvarado score	0.360	1.434	0.886-2.319	0.142
Diameter of Appendicitis	-1.077	0.341	0.226-0.515	<0.001
Duration of Complaint	-0.074	0.929	0.897-0.961	<0.001
P< 0.05 is statistically significant; WBC: white blood cells; OR:odds ratio; CI:confidence interval				

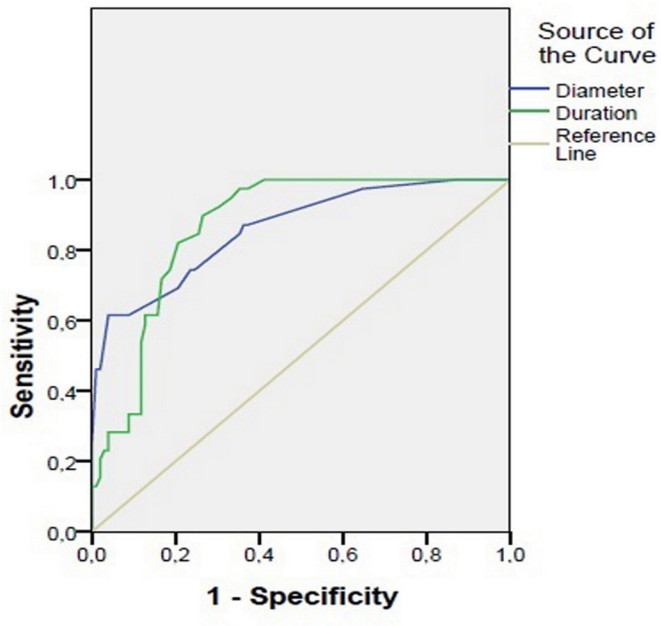

Figure 1. ROC analysis of diameter and time interval

DISCUSSION

In this prospective observational study, the factors affecting the formation of complicated appendicitis were found to be fever, diameter of appendicitis, and duration of complaints. When the other parameters were evaluated, no significant difference was observed between the two groups. The cutoff values for the diameter of appendicitis were 8.5 mm and the time interval was 10.5 hours in complicated appendicitis cases.

There are many reports in the literature concerning the association of the whole blood count parameters with underlying inflammatory or infectious pathologies. WBC elevation is quite common in the diagnosis of acute appendicitis, but is a non-diagnostic condition (8,9). Yang et al. (9) reported that the increase in the percentage of leukocytes and neutrophils was associated with the degree of appendix inflammation. Paragiotopoulou et al. (10) reported that the number of leukocytes could be used in the diagnosis of appendicitis, but it was not suitable for the differential diagnosis of perforated acute appendicitis. Similarly, Dikme et al. found that the leucocyte count did not provide significant results in the differential diagnosis

of complicated appendicitis. In the current study, the level of leukocyte was elevated in both groups in the diagnosis of acute appendicitis, but there was no significant difference between the complicated and non-complicated groups.

CT and ultrasound imaging have become standard in the diagnostic evaluation of acute appendicitis. Contrast-enhanced CT has the highest sensitivity and specificity compared to other imaging methods (11,12). The commonly described imaging characteristics of perforated appendicitis include the presence of appendiceal wall defects, extraluminal air, periappendicular fluid, and appendicolith (13). In this study, all patients suspected of appendicitis underwent CT to perform differential diagnosis and eliminate or confirm suspected appendicitis perforation. During acute appendicitis development, a blockage in the proximal segment of the lumen turns the appendix into an enclosed area. Due to the normal ongoing secretion of mucosa in the lumen, rapid effusion and distention develop in this enclosed space. The normal lumen has a low secretion level of about 1 ml or even 0.5 ml, which easily increases intraluminal pressure (11). With this pressure increase, the appendix first becomes gangrenous, and then perforation occurs. Although this process varies between individuals, the risk of perforation, which is 20% in the first 24 hours, may increase to 65% after 48 hours (14). In the current study, it was seen that 25.5% of the patients presented to the hospital 24 hours after the onset of the complaints. This duration was significantly longer in the complicated group. We consider that the time taken to present to the hospital after the onset of complaints is one of the important factors affecting the success of treatment.

For patients with suspected acute appendicitis, an appendix diameter greater than 6 mm is generally considered as a possibility of appendicitis, while a diameter greater than 10 mm is considered to indicate a great likelihood of perforated appendicitis (15). Ekici et al. showed that the critical value associated with perforation in acute appendicitis cases was 10 mm in diameter. In this study, when the largest diameter measurement of appendix was compared between the two groups, the complicated group had a statistically significantly wider diameter than the uncomplicated group. We believe that surgery should be planned without delay in patients with a 10 mm or greater appendix measured on CT performed due to the suspicion of acute appendicitis.

In cases of acute appendicitis, the body temperature may not be increased at the time of diagnosis. However, the presence of fever in patients with acute appendicitis may be an early sign that it is a complicated case. Paidipelly et al. (7) found that more patients in the complicated group had high fever compared to the non-complicated group. Similarly, Atema et al. (16) noted that the number of patients with fever was higher in the complicated group. In our study, fever was found at a significantly higher rate in the complicated group, which is consistent with the literature.

The limitations of the study include the single-centered nature, insufficient randomization of the groups due to the observational design, and the relatively small number of cases.

CONCLUSION

Complicated appendicitis is common even in today's healthcare conditions. It causes serious morbidity and high treatment costs. In patients with the diagnosis of acute appendicitis, the presence of high fever, increased appendicitis diameter, and delayed presentation increase the likelihood of complicated cases; therefore, these patients should be treated immediately.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: The study was approved by the Adıyaman University Local Ethics Committee. Nu: 2019/3-12.

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