

# Laparoscopic Appendectomy for Acute and Perforated Appendicitis: A Comparative Analysis

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## ABSTRACT

**Objective:** The purpose of this study was to compare the short-term outcomes of laparoscopically operated uncomplicated acute appendicitis and perforated appendicitis.

**Methods:** Laparoscopically operated uncomplicated acute and perforated appendicitis were screened, retrospectively. Demographics, operative variables, and postoperative complication rates were compared between the groups.

**Results:** Among 155 patients, acute appendicitis was found in 130 patients (77 [59.2%] male; median age, 32 [16–72]), while 25 patients (15 [60.0%] male; median age, 39 [17–84]) had perforated appendicitis. The duration of the operation and hospitalization period were 45 (20–105) minutes and 1 (1–6) day, respectively, in the acute appendicitis group, and 60 (20–155) minutes and 2 (1–16) days, respectively, in the perforated group. Total complication rates were statistically significantly higher in the perforated group.

**Conclusion:** Laparoscopic approach can be applied in selected cases of perforated appendicitis.

## INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdomen requiring urgent/emergent intervention.<sup>[1]</sup> It may be confused with some medical and surgical diseases due to atypical complaints. If the correct diagnosis is not made, complications such as perforation may be encountered due to delayed diagnosis.<sup>[2]</sup> Indeed, the vast majority of appendicitis cases are not complicated. However, 18.3%–34% of appendicitis cases are perforated, which significantly increases the postoperative complication rates.<sup>[3,4]</sup> In the diagnosis of perforated appendicitis, in addition to the symptoms and physical examination, ultrasonography (USG) and computed tomography (CT) are also in use.

We aimed to analyze the short-term results of laparoscopic surgery on perforated appendicitis cases by comparing them with acute appendicitis cases. We also aimed to evaluate the accuracy of USG and CT in the diagnosis of perforated appendicitis.

## MATERIAL AND METHODS

This study was performed at Department of General Surgery, Medipol University Medical School, between March 2014 and March 2018. Patients who were diagnosed with acute or perforated appendicitis were retrieved retrospectively. Pregnant women, patients younger than 16 years old, and plastronated and neoplastic patients were excluded. All of the patients who gave their written informed consent were operated laparoscopically under general anesthesia. A Veress needle was inserted through an umbilical incision, and the abdomen was insufflated with carbon dioxide. One 10 mm trocar was inserted at the umbilicus, and two 5 mm trocars were inserted at the suprapubic region and the left lower quadrant. The appendix mesentery was dissected with Ligasure. The appendix radix was closed with endo-loop, endo-stapler, or suture ligation. The specimen was removed within an endoscopic specimen bag or directly through the trocars. All specimens were sent to a pathological examination.

The patients were divided into two groups according to the operation notes as those with acute or perforated appendicitis. The demographic information of the patients included in the study, the USG and CT findings at the time of admission, the duration of the operation, and the complications were recorded. Sensitivity, specificity, the positive predictive value (PPV), and the negative predictive value (NPV) of USG and CT for perforated appendicitis were examined. Because, there were no direct interactions with subjects, and the knowledge gained would not affect subject's clinical care, an institutional review board approval and informed consent were not obtained.

### Statistical analysis

Data were analyzed using the SPSS 21.0 for Windows (Armonk, NY, IBM Corp). Results were expressed as percentages or median and ranges. Quantitative and qualitative variables were compared with the Mann–Whitney U test and chi-squared (Pearson's or Fischer's exact) tests, respectively. A p-value less than 0.05 was considered to be significant.

## RESULTS

A total of 155 patients were included in the study (92 [59.4%] men; median age=32 (16–84); body mass index (BMI)=24.9 (17.6–39.9) kg/m<sup>2</sup>). Acute appendicitis was detected in 130 (77 [59.2%] male, median age=32 [16–72]), and perforated appendicitis was detected in 25 patients (15 [60.0%] male, median age=39 (17–84)). The American Society of Anesthesiologists scores of the patients were not significantly different between the groups (Table 1).

In the preoperative period, USG was performed in 70 (53.8%) patients with acute appendicitis and in 9 (36.0%) patients with perforated appendicitis. In patients with acute appendicitis, USG was reported as acute appendicitis (n=51 [72.9%], normal [n=12, 17.1%], and perforated appendicitis [n=5, 7.1%]), and not visualized (n=2, 2.9%), while in patients with perforated appendicitis, these ratios were n=4 (44.4%), n=2 (22.2%), n=2 (22.2%), and n=1 (11.1%), respectively. Therefore, sensitivity, specificity, PPV, and NPV were 8%, 91.5%, 28.6%, and 70.1%, respectively, for USG.

Preoperatively, CT was performed in 100 (76.9%) patients with acute appendicitis and 24 (96.0%) with perforated appendicitis. Patients with acute appendicitis were evaluated as having acute appendicitis (n=97, 97.0%) and normal (n=3, 3.0%), while in the perforated appendicitis group, the CT was reported as perforated appendicitis (n=15, 62.5%), acute appendicitis (n=8, 33.3%), and normal (n=1, 4.2%). Sensitivity, specificity, PPV, and NPV were 60%, 100%, 100%, and 91.2%, respectively, for CT.

All patients were treated with the laparoscopic technique, and in only one patient (4.0%) with perforated appendicitis, conversion was required. There were statistically significant differences between the groups in terms of the appendiceal stump closure methods (endo-loop, endo-stapler, and suture ligation). There was no difference

**Table 1.** General features of study participants

	Acute appendicitis (n=130)	Perforated appendicitis (n=25)	p
Age	32 (16–72)	39 (17–84)	0.027
Gender			0.943
Male	77 (59.2)	15 (60.0)	
Female	53 (40.8)	10 (40.0)	
BMI	24.9 (17.6–39.9) (n=122)	26.5 (21.3–37.6) (n=24)	0.071
ASA Score			0.150
ASA I	102 (78.5)	16 (64.0)	
ASA II	19 (14.6)	7 (28.0)	
ASA III	1 (0.8)	1 (4.0)	
Unknown	8 (6.2)	1 (4.0)	

BMI: Body mass index; ASA: American Society of Anesthesiologists Classification.

**Table 2.** Operative findings

	Acute appendicitis (n=130)	Perforated appendicitis (n=25)	p
Conversion to open surgery	0	1 (4.0)	0.161
Appendix closure			0.001
Endo-loop	129 (99.2)	21 (84.0)	
Endo-stapler	0	3 (12.0)	
Suture ligation	1 (0.8)	1 (4.0)	
Specimen extraction			0.966
Endo-bag	63 (48.5)	12 (48.0)	
Direct	67 (51.5)	13 (52.0)	
Operation time (minute)	45 (20–105) (n=120)	60 (20–155) (n=24)	0.001
Length of stay (day)	1 (1–6)	2 (1–16)	0.000

**Table 3.** Complications

	Acute appendicitis (n=130)	Perforated appendicitis (n=25)	p
Wound infections	7 (5.4)	6 (24.0)	0.008
Intraabdominal abscess	0	5 (20.0)	0.000
Atelectasis	1 (0.8)	0	0.999
Ileus	1 (0.8)	0	0.999
Total	9 (6.9)	11 (44.0)	0.000

between the groups in terms of the specimen extraction methods (acute appendicitis group: n=63, 48.5%; perforated appendicitis group: n=12, 48.0%, with endoscopic specimen retrieval bag; p=0.966). The duration of operation in the acute appendicitis group was shorter than that

in the perforated appendicitis group (45 [20–105] min versus 60 [20–155] min,  $p=0.001$ ). The length of hospital stay was also shorter in favor of acute appendicitis (Table 2).

More complications were observed in the perforated appendicitis group (11 [44.0%] versus 9 [6.9%]). All patients who developed complications were discharged without any problems (Table 3).

## DISCUSSION

In this study, operative findings and complications of perforated appendicitis cases were compared with cases of acute appendicitis. In the perforated appendicitis group, the duration of hospital stay was longer, and the complications were more frequent.

Delay in the diagnosis and operation of appendicitis causes an increase in the perforation, morbidity, and mortality rates.<sup>[5]</sup> In the study by Barreto et al.,<sup>[6]</sup> perforation was more common in males and in patients over 60 years of age; Tanrikulu et al.<sup>[7]</sup> reported that both groups were similar in terms of gender and age. In our study, the groups were similar in terms of gender, whereas patients in the perforated group were older. In obese patients, it is difficult to diagnose acute appendicitis, and the risk of perforation is high because the rate of false diagnosis is high.<sup>[8,9]</sup> In our study, the BMI was higher in the perforated group, although the difference was not statistically significant.

In the study by Ay et al.,<sup>[10]</sup> the mean duration of operation of the acute appendicitis was 40 minutes, and the length of hospital stay was 1 day, while the operation time of perforated appendicitis was 54 minutes, and hospitalization time was 2 days. In our study, the duration of operation and hospital stay in acute appendicitis was also significantly shorter.

The rate of total complications after laparoscopic appendectomy for perforated appendicitis was 12.8%–39.5% in various studies.<sup>[11–13]</sup> In our study, this rate was 44.0%. Ay et al.<sup>[10]</sup> found wound infections in three patients (6.4%) in acute appendicitis and 4 (10.7%) in perforated appendicitis. In our study, wound infections were significantly more common in the perforated appendicitis group. Rickert et al.<sup>[14]</sup> detected intraabdominal abscess in one patient (1%), while we detected them in 5 (3.2%) patients. These patients were treated with antibiotics without drainage. Ay et al.<sup>[10]</sup> reported ileus in 2 (7.1%) patients in the perforated appendicitis group, whereas in our study, only 1 (0.6%) patient with acute appendicitis developed ileus. All patients with postoperative complications were discharged without any problems, and mortality was not observed in our series.

A retrospective study design and a low number of patients in the group limit the validity of the data in our study.

## CONCLUSION

Patients with perforated appendicitis had a longer duration of operation and hospitalization, with higher complication

rates. Laparoscopic approach can be applied in selected cases of perforated appendicitis.

### Informed Consent

Retrospective study.

### Peer-review

Internally peer-reviewed.

### Authorship Contributions

Concept: M.C.H., N.O.; Design: M.C.H.; Data collection &/or processing: M.C.H.; Analysis and/or interpretation: N.O.; Literature search: N.O.; Writing: M.C.H., N.O.; Critical review: M.C.H., N.O.

### Conflict of Interest

None declared.

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## Akut ve Perfore Apandisitlerde Laparoskopik Apendektomi: Karşılaştırmalı Analiz

**Amaç:** Bu çalışmanın amacı akut komplike olmamış apandisitler ile perfore apandisitlerde laparoskopinin kısa dönem sonuçlarını karşılaştırmaktır.

**Gereç ve Yöntem:** Akut apandisitler tanısıyla laparoskopik apendektomi uygulanmış tüm hastaların kayıtları geriye dönük olarak derlendi. Akut ve perfore apandisit gruplarında demografik veriler, operasyon değişkenleri ve ameliyat sonrası komplikasyon oranları karşılaştırıldı.

**Bulgular:** Toplam 155 hastanın 130'unda (77 [%59.2] erkek, ortalanca yaş: 32 [16–72]) akut apandisit saptanmış olup 25 hastada (15 [%60.0] erkek, ortalanca yaş: 39 [17–84]) perfore apandisit saptandı. Operasyon süreleri ve hastanede kalış süreleri akut apandisit için 45 (20–105) dakika ve bir (1–6) gün olup perfore apandisit grubunda 60 (20–155) dakika ve iki (1–16) gün idi. Toplam komplikasyon oranları perfore apandisit grubunda anlamlı olarak daha fazlaydı.

**Sonuç:** Seçilmiş perfore apandisit olgularında laparoskopik apendektomi uygulanabilir.

**Anahtar Sözcükler:** Apandisit; komplikasyon; laparoskopik; perforasyon.