

# Laparoscopy Versus Open Appendectomy for Elderly Patients: A Single-Center Experience

Yaşlı Hastalarda Laparoskopik ve Açık Apendektominin Karşılaştırılması:  
Tek Merkez Deneyimi

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## Abstract

Objective	Acute appendicitis rates are gradually increasing in the elderly people population with prolonged life expectancy. This study aims to compare applicability of laparoscopic and open surgical methods in patients treated surgically for acute appendicitis over 65 years of age.
Materials and Methods	Patients over 65 years old who underwent surgical treatment for acute appendicitis at the Sakarya University Hospital between 2011-2018 were included in the study. The patients were classified according to the surgical method applied as laparoscopic or open appendectomy and complicated or non-complicated appendicitis. All groups were evaluated in terms of mean age, gender, white blood cell (WBC) levels, presence of comorbid disease, ASA score, operation time, the onset of oral intake, duration of hospital stay, postoperative intensive care requirement, presence of complications and mortality.
Results	Of the 161 patients who underwent appendectomy over 65, 98 were male (% 60,80) and 63 were female (% 39,20). It was determined that open appendectomy was performed in 109 (% 67,70) of the cases, and laparoscopic appendectomy in 52 (% 32,29). It was determined that 61 (% 55,91) of 109 cases undergoing open surgery and 22 (% 42,32) of 52 cases undergoing laparoscopic appendectomy were complicated acute appendicitis. Complications were observed in 24 (% 14,94) of one hundred and fifty patients. In terms of complications, no significant difference was found between laparoscopically operated groups and open appendectomy groups (P=0,873).
Conclusion	Laparoscopic appendectomy is considered as a safely feasible method in the population of elderly and high comorbid patients.
Keywords	Appendicitis; Laparoscopy; Elderly.

## Öz

Amaç	Akut apandisit acil cerrahide sık görülen patolojilerdendir. Genellikle genç yaşta görülen bir hastalıktır. Ortalama yaşam süresinin uzaması ile yaşlı hasta popülasyonunda akut apandisit görülme oranları giderek artmaktadır. Bu çalışmanın amacı, 65 yaş üstü akut apandisit nedeni ile cerrahi olarak tedavi edilen hastalarda laparoskopik ve açık cerrahi yöntemlerin sonuçlarını karşılaştırmaktır.
Gereç ve Yöntemler	2011-2018 yılları arasında Sakarya Üniversitesi Tıp Fakültesi Eğitim ve Araştırma Hastanesi'nde akut apandisit nedeni ile cerrahi tedavi uygulanan 65 yaş üstündeki olgular çalışmaya dahil edildi. Olgular uygulanan cerrahi yöntemlere göre laparoskopik veya açık apendektomi ve komplike veya nonkomplike apandisit olarak değerlendirilerek sınıflandırıldı. Tüm gruplar yaş ortalaması, cinsiyet, beyaz küre (WBC) düzeyleri, komorbid hastalık varlığı, ASA skoru, operasyon süresi, oral alımın başlama zamanı, hastanede kalış süresi, postoperatif yoğun bakım gereksinimi, komplikasyon varlığı ve mortalite açısından değerlendirildi.
Bulgular	65 yaş üstü apendektomi yapılan 161 olgunun 98'i erkek (% 60,80), 63'ü kadındı (% 39,20). Olguların 109'una (% 67,70) açık apendektomi, 52'sine (% 32,29) laparoskopik apendektomi uygulandığı belirlendi. Açık operasyon uygulanan 109 olgunun 61'inin (% 55,91), laparoskopik apendektomi uygulanan 52 olgunun 22'sinin (% 42,32) komplike akut apandisit olduğu saptandı. Opere edilen olguların 24'ünde (% 14,94), komplikasyon geliştiği gözlemlendi. Komplikasyonlar açısından laparoskopik opere edilen gruplarla açık apendektomi grupları arasında anlamlı farklılık saptanmadı (P=0,873). Gruplar yaş, cinsiyet, yandaş hastalık, ASA skoru ve preoperatif laboratuvar değerleri açısından benzer özellikler göstermekteydi.
Sonuç	Laparoskopik apendektomi yaşlı ve komorbiditesi yüksek hasta popülasyonunda güvenle uygulanabilir bir yöntemdir.
Anahtar Kelimeler	Apandisit; Laparoskopi; Yaşlı hasta

## INTRODUCTION

Acute appendicitis is one of the most common pathologies in emergency surgery.<sup>1</sup> It more frequently affects the younger age groups, with 70% of diagnosed cases under the age of 30. With the increase seen in the average life span, incidences of acute appendicitis have been increasing in the elderly.<sup>2</sup> According to the literature, the incidence of acute appendicitis is 8.6% in men and 6.7% in women in the general population, while incidences of acute appendicitis in patients over the age of 60 are 5–10%.<sup>3</sup>

The increase in life expectancy seen over the last few decades has brought the use of minimally invasive surgical interventions in the elderly patients into question. Currently, appendectomy is the standard treatment for acute appendicitis, while for surgical treatments of acute appendicitis, laparoscopic appendectomy is preferred over open surgical methods due to the shorter hospital stay, the shorter time to return to daily life and the fewer wound site complications.<sup>4</sup>

Despite the advantages offered by laparoscopic surgery, the use of the laparoscopic method for the surgical treatment of acute appendicitis in the elderly population is controversial due to the greater rate of comorbidities and the more complicated course of acute appendicitis in this group.<sup>5</sup> The present study compares the applicability of laparoscopic and open surgery in patients aged 65 and over who were operated for acute appendicitis.

## MATERIALS and METHODS

This is a descriptive, cross sectional and retrospective study. The data of patients who were operated for acute appendicitis at Sakarya University Medical Faculty Training and Research Hospital between 2011 and 2018 was screened and analyzed. Only cases aged 65 and over were included. Appendectomies under the age of 65, appendectomies performed as part of another operation, negative appendectomies and elective appendectomies were excluded from the study. The cases were classified as laparoscopic

or open appendectomy, and as complicated or non-complicated appendicitis, in terms of the surgical method. Perforated ap-pendicitis according to perioperative evaluation, and gangrenous appendicitis with or without abscess formation were identified as complicated cases. The cases were classified into four groups, the complicated open appendectomy (COA) group, the non-complicated open appendectomy (NCOA) group, the complicated laparoscopic appendectomy (CLA) group and the non-complicated laparoscopic appendectomy (NCLA) group. All groups were assessed for mean age, gender, white blood cell (WBC) count, presence of comorbid diseases, American Society of Anesthesiology (ASA) score, duration of operation, onset of oral intake, length of hospital stay, need for postoperative intensive care (ICU), presence of complications and mortality.

Acute appendicitis was diagnosed based on the findings of physical examination, laboratory data and abdominal tomography.

The laparoscopic appendectomies were performed with three trocars (10-mm umbilical, 10-mm left lower quadrant and 5-mm suprapubic) under general anesthesia. The maximum intraabdominal pressure applied was 12 mmHg. The mesoappendix was divided with a ligature and the radix was closed using two loop sutures or a hemostatic clip. The appendectomy specimen was removed from the abdomen using a plastic bag via the 10-mm trocar placed in the left lower quadrant. For gangrenous and perforated cases, the appendectomy location was irrigated with 2–3 L of 0.9% physiological saline and aspirated; and for complicated cases, an aspiration drainage tube was placed in the appendectomy location.

## Statistical analysis

The Kolmogorov–Smirnov test was used to determine if the continuous and intermittent numerical variables showed normal distribution, and the homogeneity of variances were investigated with the Levene test. Descriptive

statistics of continuous and intermittent numerical variables are expressed as mean  $\pm$  standard deviation or median (minimum–maximum), while categorical variables are expressed as number of cases and percent (%).

Among the groups, the parameters evaluated, the significance of the difference was evaluated by One-Way ANOVA and Kruskal Wallis test. If the Kruskal Wallis test statistics results were found to be significant, the situation(s) that caused the difference were determined using Dunn's multiple comparison test.

If at least one of the 2x2 cross tables had an expected frequency below 5, categorical data were assessed using Fisher's Exact Test, while when the expected frequency was between 5 and 25, the Continuity Corrected Chi-Square test was used; otherwise, Pearson's Chi-Square test was conducted. Analyses of categorical data in cross-tabulations of RxC (if at least one of the categorical variables in the row or column were duplicate outcomes) were done using Pearson's ChiSquare test.

Analysis of the data was performed using IBM SPSS Statistics 17.0 (IBM Corporation, Armonk, NY, USA). For  $p < 0.05$ , the results were considered statistically significant. The study was approved by the Sakarya University Ethics Committee with the date of 29.05.2020 and the number E-8722. The study was conducted in accordance with the Helsinki declaration.

## RESULTS

Of the 4,761 surgical treatments for acute appendicitis at the Sakarya University Medical Faculty Training and Research Hospital between 2011 and 2018, 161 (% 3,38) cases aged over 65 were included in this study. Of those who underwent an appendectomy, 98 (% 60,80) were male and 63 (% 39,20) were female. One hundred and nine (% 67,70) of the cases had open, and 52 (% 32,29) had laparoscopic appendectomies. A traditional left lower quadrant Mc Burney incision was preferred in 103 (% 94,41), while a

midline incision was preferred in six (% 5,62) cases who underwent an open appendectomy. Complicated acute appendicitis was the case in 61 (% 55,96) of the 109 open appendectomies and in 22 (42,30%) of the 52 laparoscopic appendectomies. The mean ages of the cases and the white blood cell counts were similar in all groups. Two (% 9,09) of the cases from the CLA group and one (% 1,60) case from the COA group were monitored in the intensive care unit postoperatively for one day. In two of the cases in the CLA group, the operation was switched to open surgery due to adhesion. All groups were similar in terms of age, gender, accompanying diseases, ASA score and preoperative laboratory values (Table 1).

All of the study cases were evaluated with a preoperative intravenous contrastenhanced abdominal computed tomography (CT). The parameters for an acute appendicitis diagnosis included increased appendiceal wall thickness, the presence of perforation, periappendicular free air and the identification of a periappendicular/intraabdominal abscess on the abdominal CT. In the preoperative CT assessment, 78 (% 48,42) (NCLA: 30, NCOA: 48) of the cases were identified as non-complicated appendicitis, and 83 (% 51,58) (NCLA: 22, COA: 61) as complicated appendicitis due to the presence of perforation and periappendicular abscesses.

The comorbid diseases detected in all groups are summarized in Table 2, cardio-vascular disease and diabetes mellitus are the most common in both the laparoscopic and open appendectomy groups. The other comorbid diseases identified were hypertension, bronchopulmonary disease, renal disease, cerebrovascular disease and anticoagulant use.

There were no mortalities within the first postoperative 30 days in any of the cases included in the study. Complications developed in 24 (% 14,90) of the operated cases (Table 3), with the most common postoperative complication being wound site infection, with 10 (% 6,20) cases. A postoperative intraabdominal abscess occurred in a total

**Table 1: Clinical and operational parameters of the appendectomy groups**

Patients Charesteristics (n=161)	Complicated Open Appendectomy (COA) (n= 61)	Noncomplicated Open Appendectomy (NCOA) (n=48)	Complicated Laparoscopic Appendectomy (CLA) (n= 22)	Noncomplicated Laparoscopic Appendectomy (NCLA) (n= 30)	P Value
Age (Year)	72,12±6.14	71,20±5.92	73,24±6.37	70,07±5.57	0,091†
Sex(M/F)	40/21	30/18	12/10	16/14	0,422‡
ASA SCORE					0,823‡
ASA 1	13	10	9	11	
ASA 2	44	35	10	18	
ASA 3	4	3	3	1	
WBC	14,7±4,1	13,7±3,5	15,1±4,5	13,1±3,2	0,820‡
Operation Time (minute)	65,82±24,26	54,12±20,14	90,17±29,2	60,21±22,65	0,520\$
Use of drain	58 (% 95)a	9 (% 18,75)a	19 (% 86,3)b	5 (% 16,6)b	0,009a†
					0,016b†
Oral intake time	1,9±0,56	1,2 ±0,39	1,6±0,62	1,15±0,48	0,640†
Length of stay (days)	6,98 ±4,21	4,88± 3,47	5,28 ±3,93	3,72±2,89	0,110†
ICU admission	1	-	2	-	0,999‡
Mortality	-	-	-	-	-

† One-Way ANOVA, ‡ Pearson's Chi-Square test, \$ Kruskal Wallis test, a: The difference between complicated and non-complicated open appendectomy groups in terms of drain usage was statistical-ly significant (p=0,009). b: The difference between complicated and non-complicated laparoscopic appendectomy groups in terms of drain usage is statistically significant (p=0,016). COA: Complicated Open Appendectomy, NCOA: Non-complicated Open Appendec-tomy, CLA: Complicated Laparoscopic Appendectomy, NCLA: Non-complicated Laparoscopic Appendectomy, M: Male, F: Female, ASA: American Society of Anesthesiologists, WBC: White Blood Cell, ICU: Intensive Care Unit

**Table 2: Comorbid conditions in the all appendectomy groups**

Comorbidities	Complicated Open Appendectomy (COA) (n= 61)	Noncomplicated Open Appendectomy (NCOA) (n=48)	Complicated Lapa-rosopic Appendec-tomy (CLA) (n= 22)	Noncomplicated Lapa-rosopic Appen-ectomy (NCLA) (n= 30)	p Value
Cardiac disease	28(%17,39)	21(%13,04)	9(%5,59)	11(%6,83)	0,592‡
Hypertension	18(%11,18)	17(%10,55)	8(%4,96)	7(%4,34)	0,589‡
Broncopulmoner disease	4(%2,48)	3(%1,86)	3(%1,86)	2(%1,24)	0,091‡
Renal failure	2(%1,24)	1(%0,62)	-	1(%0,62)	0,854‡
Diabetes Mellitus	24(%14,90)	20(%12,42)	12(%7,45)	10(6,21)	0,127‡
Cerebrovascular disease	7(%4,34)	6(%3,72)	3(%1,86)	4(%2,48)	0,154‡
Anticoagulan use	20(%12,42)	17(%10,55)	8(%4,96)	7(%4,34)	0,645‡

‡ Pearson's Chi-Square test, COA: Complicated Open Appendec-tomy, NCOA: Non-complicated Open Appendectomy, CLA: Compli-cated Laparoscopic Appendectomy, NCLA: Non-complicated Lapa-rosopic Appendectomy,

of four (% 2,41) (CLA: 2, COA: 2) cases, who were treated with percutaneous drainage and intravenous antibiotics. None of the cases required reoperation. A postoperative ileus was identified in two (% 1,20) (COA: 1, CLA: 1) cases, and postoperative atelectasis in four (% 2,4) (COA: 3, NCOA: 1) openly operated cases and three (% 1,86) (CLA: 2, NCLA: 1) laparoscopically operated cases. A single (% 0,60) case from the NCLA group experienced port-site bleed-ing. Furthermore, one (% 0,60) case from the CLA group suffered a postoperative pulmonary embolism and medical treatment was initiated. No statistically significance detected between the groups in terms of postoperative complications: Surgical site infection (p=0,885), intraabdominal abscess (p=0,253), atelectasis (p=0,234) (Table 3).

When the groups were evaluated in terms of length of hospital stay, the NCLA group had a shorter hospital stay than the other groups, although the difference was not statistically significant (p=0,110) (Table 1).

### DISCUSSION

Several recent studies about the use of minimally invasive surgical methods have demonstrated the superiority of laparoscopic surgical methods over open surgery.<sup>6</sup> The use of laparoscopic methods over open surgery is currently increasing due to reasons such as reduced postoperative

pain, shorter hospital stays, shorter time to return to daily life and fewer surgical site infections.<sup>7</sup>

Acute appendicitis is a condition that usually affects the young population. The possibility of acute appendicitis in the second and third decades is reported to be 9% and 7% in men and women, respectively.<sup>8</sup> Literature reports the prevalence of acute appendicitis to be 5–10% in the elderly population.<sup>9</sup> The prolonged average lifespan and the associated increase in elderly population have resulted in an increased incidence of acute appendicitis in the geriatric age group.<sup>10</sup>

In elderly patients, the most distinctive clinical symptom of acute appendicitis is pain in the lower abdomen. As the most distinct symptom of acute appendicitis, pain in the right lower quadrant is more subtle in elderly people than in younger patients. The classic triad of appendicitis, being right lower quadrant tenderness, fever and leukocytosis, is detected in only 26% of patients in the elderly population treated for acute appendicitis.<sup>11</sup> The use of laparoscopy in the surgical treatment of acute appendicitis has increased in parallel with technological and anesthetic developments.<sup>12</sup>

Laparoscopic surgery is preferred more for the geriatric patient group in terms of being less invasive and allowing

Comorbidities	Complicated Open Appendectomy (COA) (n= 61)	Noncomplicated Open Appendectomy (NCOA) (n=48)	Complicated Laparoscopic Appendectomy (CLA) (n= 22)	Noncomplicated Laparoscopic Appendectomy (NCLA) (n= 30)	p Value
Surgical site infections	5 (% 8,19)	2 (% 4,16)	1 (% 4,45)	2 (% 6,66)	0,885‡
Intraabdominal abscess	2 (% 3,22)	-	2 (% 9,09)	-	0,253‡
Ileus	1 (% 1,63)	-	1 (% 4,54)	-	0,257‡
Atelectasis	3 (% 4,91)	1 (% 2,08)	2 (% 9,09)	1 (% 3,33)	0,234‡
Pulmonary embolism	1 (% 1,63)	-	-	-	-
Port site bleeding	-	-	-	1 (% 3,33)	-

‡ Pearson's Ki-Kare test, COA:Complicated Open Appendectomy, NCOA:Non-complicated Open Appendectomy, CLA:Complicated Laparoscopic Appendectomy, NCLA:Non-complicated Laparoscopic Appendectomy,

to make a proper differential diagnosis and also treating most of them, even; diagnosing acute appendicitis is already a challenging procedure itself.<sup>13</sup>

There are numerous studies supporting the safety of the laparoscopic technique for the surgical treatment of acute appendicitis.<sup>14</sup> The use of the laparoscopic technique for complicated acute appendicitis, such as perforation, abscess and gangrene which are rather common in elderly patients, is somewhat controversial. Several authors argue that the laparoscopic technique increases the formation of postoperative intraabdominal abscesses in complicated appendicitis, due to longer operation duration with laparoscopy than with the open method and the CO<sub>2</sub> insufflation.<sup>15</sup> Other authors argue that the formation of postoperative in-traabdominal abscesses is reduced by the irrigation and aspiration in complicated cases treated laparoscopically.<sup>16</sup> The present study identified postoperative abscess in two cases in the CLA group and two cases in the COA group, all of whom were evaluated as perforated and complicated appendicitis in preoperative imaging. When the laparoscopic and open methods were compared in terms of postoperative abscess frequency, however, no statistically difference was apparent between the groups ( $p=0.253$ ).

Irrespective of the surgical method chosen, the most common postappendectomy complication is wound site infection. Literature reports fewer wound site infections with the laparoscopic surgery when compared to open surgical methods, due to the fact that the appendectomy specimen is usually removed from the abdomen in a plastic bag.<sup>17</sup> Gupta et al found that the CO<sub>2</sub> insufflation used in laparoscopic appendectomy is likely to cause a bacterial increase in the peritoneal cavity, leading to an increase in surgical site infections, while many other authors assert that the laparoscopic surgery provides a better surgical view, and that intraabdominal drainage is easier with the laparoscopic method.<sup>18-19</sup> In the present study, wound site infections occurred in three (1.86%) (NCLA: 2 and CLA:

1) laparoscopically operated cases and in seven (4.34%) (COA: 5 and NCOA: 2) openly operated cases. Despite the greater frequency of wound site infections in the open method group, there was no statistically significant difference between the two groups in this regard ( $p=0,885$ ).

Surgical experience is the most important parameter determining the duration of the operation in minimally invasive interventions. Numerous studies have found laparoscopic appendectomy to require more time than an open operation. A study by Galli et al, however, found that shorter operation durations can be achieved as laparoscopic experience increases when compared to the open method.<sup>20</sup> The prolonged duration of the laparoscopic method can be explained by the longer installation time of the laparoscopic system, the aspirationirrigation process in complicated cases and the longer time required to release secondary adhesions when compared to the open method. Although the present study identified distinctively longer operation durations in CLA cases than in the other groups, no statistically significant difference was detected ( $p=0,520$ ) and mortality was not the case in any of the patients.

The distinct advantage of laparoscopic appendectomy over open appendectomy is the shorter hospital stay, and there have been several studies reporting shorter hospital stays for patients treated with laparoscopic appendectomy.<sup>21</sup> In the present study, the length of hospital stay was shorter in the NCLA group than in the other groups, while there was no notable difference in the length of stay for the other groups ( $p=0,110$ ) (Table 1).

The acid-base equilibrium changes, and cardiac and pulmonary effects of the pneumoperitoneum produced during laparoscopic procedures usually have an impact on the selection of the surgical procedure in the elderly, and makes the laparoscopic choice difficult. On the other hand, recent developments in anesthesia and postoperative care conditions have led to an increase in the feasibility of more complicated laparoscopic operations in the elderly.<sup>22</sup> In the

present study, an intraabdominal CO<sub>2</sub> insufflation was performed with a pressure of 12 mm Hg in the laparoscopic appendectomy technique, with the patients in the left lateral position with the head down during the operation. Considering the postoperative complications, the present study identified no notable statistical difference between the laparoscopically and openly operated elderly patients (Table 3). There were fewer wound site infections in the laparoscopy group than the open surgery group, and operation duration was prolonged in the laparoscopic complicated appendicitis group; both findings did not achieve statistical significance. In conclusion, laparoscopic appendectomy seems to be safe and appropriate for elderly, with similar postoperative outcomes of the open surgery.

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