Research Article

International Journal of Gastroenterology and Hepatology

Comparison Of Laparoscopic Versus Open Appendectomy Outcomes In Elderly (≥ 65 Years) Patients With Acute Appendicitis

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Ethical Disclosures:
Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study. Confidentiality of data. The authors declare that no patient data appear in this article. Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Received Date: 13 March 2024
Accepted Date: 22 March 2024
Published Date: 28 March 2024

Citation:
Bora Barut. Comparison Of Laparoscopic Versus Open Appendectomy Outcomes In Elderly (≥ 65 Years) Patients With Acute Appendicitis. International Journal of Gastroenterology and Hepatology 2024.

1. Abstract

1.1. Background:
In this study, we aimed to compare the intraoperative and postoperative outcomes of elderly patients undergoing laparoscopic or open appendectomy for acute appendicitis.

1.2. Materials and methods:
Between March 2018 and March 2022, 67 patients (aged ≥ 65 years) underwent laparoscopic or open appendectomy for acute appendicitis were analyzed retrospectively. Demographic, laboratory data, and postoperative outcomes were examined. Normality analysis was performed for the groups. Data were analyzed using Mann-Whitney U and Pearson chi-square tests. P<0.05 was considered statistically significant.

1.3. Results: The median age of the patients was 71 (range: 65-92) years and 50.7% of the patients were female. Laparoscopic appendectomy was performed in 50.7% of the patients. It was noted that 52.2% of the population had complicated findings in perioperative assessments. While the operation times were shorter in the open appendectomy group with a statistically significant difference (p = 0.007), there was no significant difference between the groups in terms of postoperative complications (p = 0.461), hospitalization times (p = 0.238) and mortality. However, postoperative complication rates (p=0.040) and length of hospital stay (p=0.027) were longer in patients with complicated appendicitis undergoing laparoscopic appendectomy.

1.4. Conclusion:
It was observed that there was no difference between surgical technique and postoperative outcomes of patients. However, in patients with complicated appendicitis, we recommend that the open technique be preferred, which is superior to laparoscopic appendectomy in terms of postoperative results.

2. Keywords:
Acute appendicitis, Elderly patients, Laparoscopic appendectomy, Open appendectomy.

3. Introduction

Acute appendicitis (AA) stands as one of the prevailing causes of acute abdomen encountered in general surgery, with a lifetime risk ranging from 7-8%. Global advancements in medicine and technology have led to an increase in life expectancy worldwide.1,2 However, this demographic shift has posed challenges in the surgical management of diseases, especially among elderly individuals who often present with comorbidities such as cardiovascular,pulmonary, or neurological disorders. The atypical presentation and delayed diagnosis in elderly patients complicate the management of AA.3,4 Since the inaugural laparoscopic appendectomy (LA) performed by Kurt Semm in 1983, laparoscopic techniques have gained preference over conventional open appendectomy (OA) in treating AA. Despite the advantages of LA, such as reduced pain, swifter recovery, and fewer postoperative complications, it is associated with a higher incidence of intra-abdominal abscess formation.5Giventhe elevated risk of mortality in elderly patients with acute appendicitis compared to the general population, the choice of surgical procedure becomes even more critical in this demographic.6 In this study, our objective was to compare the outcomes of patients aged 65 and above who underwent either laparoscopic or open appendectomy for acute appendicitis.

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4. Materials and Methods

4.1 Patient selection and study design

After obtaining approval from the local ethics committee, we conducted a retrospective analysis of 67 patients aged 65 and above who underwent LA or OA for AA at our clinic between March 2018 and March 2022. The patients were categorized into two groups based on the surgical technique employed; LA and open appendectomy OA groups. Various demographic parameters of the patients, including age, gender, American Society of Anesthesiologists (ASA) score, comorbid conditions, intraoperative findings, histopathological diagnoses, duration between symptom onset and surgery, preoperative radiological assessments, preoperative white blood cell (WBC) count, C-reactive protein (CRP) level, appendix diameter, operation duration, presence of intra-abdominal drain, withdrawal time of the drain, postoperative complications, management of complications, and length of hospital stay, were systematically reviewed for each group.

4.2 Patient management

The diagnosis of AA was established based on physical examination findings, as well as laboratory and radiological assessments, including ultrasonography and/or computerized tomography. Patients with incomplete data, absence of appendicitis according to pathological reports, and those who underwent appendectomy for reasons other than AA during the same surgical session were excluded from the study. OA was performed through McBurney, right lower para-median, or subumbilical midline incisions. For LA, pneumoperitoneum was created using a Veres needle in the subumbilical region, maintaining intraabdominal pressure between 12-14 mmHg throughout the procedure. A 10-mm trocar was inserted subumbilically for camera placement, and two additional trocars were positioned—one 5-mm trocar in the midline just above the pubis and another 10-mm trocar on the left side, symmetrically opposite the McBurney point. The appendicular artery was coagulated using an electrothermal bipolar vessel sealing device. Appendectomy was completed using two handmade endoloops or polymer ligating clips, and the removed appendix was placed in a handmade bag made from a surgical glove for extraction.

5. Statistical analysis

We determined that a minimum of 62 patients (31 in each group) was required to achieve adequate statistical power for our study, calculated based on odds ratios obtained from logistic regression analysis, with a 95% confidence level and 80% power. The normality of data distribution was assessed using the Shapiro-Wilk test. Nonparametric tests, specifically the Mann-Whitney U test, were applied due to the non-normal distribution. Descriptive statistics including median, minimum, and maximum values were provided for the variables. Chi-square analysis was utilized for categorical variables, with statistical significance set at $p < 0.05$.

6. Results

Between March 2018 and March 2022, in 67 patients (aged≥ 65 years) with AA, LA or OA was performed. The median age of population was 71 years (range: 65-92), with 34 patients (50.7%) being female. Additionally, in 34 (50.7%) patients LA was performed. According to intraoperative findings and postoperative histopathological examinations, in 35 (52.2%) patients complicated appendicitis was detected. Postoperative complications were observed in 23.9% of patients, with intra-abdominal abscess (9%) and postoperative paralytic ileus (6%) being the most common. Demographic and perioperative findings of patients were summarized at table I.

Table 1: Demographic and perioperative findings

Variables		n=67(%)	Median (Min-Max)
Gender	**Male**	33(49.3%)	
	Female	34(50.7%)	
Age (years)			71(65-92)
ASA	1	4(6%)	
	2	40(59.7%)	
	3	23(34.3%)	
CAD		13(19.4%)	
COPD		11(16.4%)	
DM		19(28.4%)	
HT		44(65.7%)	
DiagnosisMethods	US	19(28.4%)	
	CT	10(14.9%)	
	US and CT	38(56.7%)	
OperationType	Open	33(49.3%)	
	Laparascopic	34(50.7%)	
Complicated		35(52.2%)	
Drain		30(44.8%)	
Postoperative Complication	Absence	51(76.1%)	
	SSSI	1(1.5%)	
	Intraabdominalabscess	6(9%)	
	AKI	1(1.5%)	
	AF	2(3%)	
	Pneumonia	2(3%)	
	ParaliticİIeus	4(6%)	

ASA: American Society of Anes the siologists; CAD: Coronary Artery disease; COPD: chronic obstructive pulmonary disease; DM: Diabete smellitus; HT: Hypertension; US: Ultrasonography; CT: Computed tomography; SSSI: Superficial surgical site infection; AKI: Acute kidney injury; AF: atrial fibrillation

There were no statistically significant differences between the groups

in terms of age (p=0.222), gender (0.393), ASA score (0.112), or comorbidities. Intotal of 72.7% patients who underwent open appendectomy had complicated appendicitis. Regarding operation durations, LA had a median duration of 70 minutes (range: 30-120 min.), which was statistically different from OA (p=0.007). No mortality was observed in the postoperative outcomes, and there was no statistical difference between the groups in terms of postoperative complications (p=0.461) (Figure 1a) and length of hospital stay (p=0.238) (Figure 2a). Outcomes of demographic data and perioperative findings of laparoscopic and open appendectomy groups were summarized at table II.

Figure 1a. Postoperative complications of laparoscopic appendectomy (LA) and open appendectomy (OA) in complicated and uncomplicated acute appendicitis.

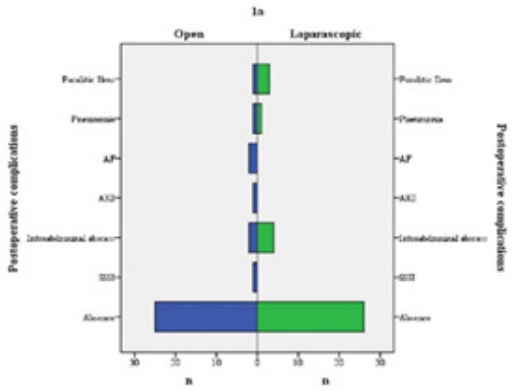
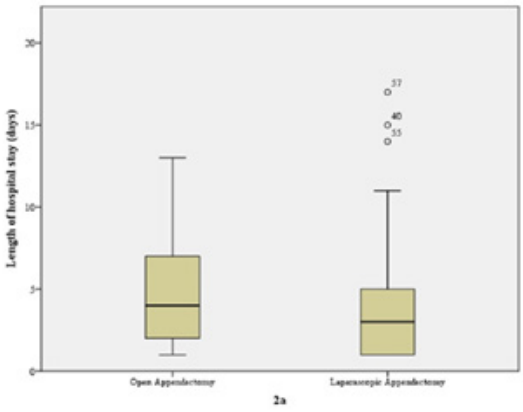


Figure 2a. Length of hospital stay for laparoscopic appendectomy (LA) and open appendectomy (OA) in complicated and uncomplicated acute appendicitis.



For complicated appendicitis cases, 68.6% underwent OA. When comparing open and laparoscopic approaches for complicated appendicitis, OA demonstrated superiority in operation duration (60 minutes [40-150] vs. 80 minutes [70-120]; p=0.027), length of hospital stay (4 days [1-13] vs. 9 days [2-17]; p=0.027) (Figure 1b), and postoperative complications (p=0.040) (Figure 2b). Outcomes of open and laparoscopic appendectomy in complicated acute appendicitis were summarized at table III.

Figure 1b. Postoperative complications of laparoscopic appendectomy (LA) and open appendectomy (OA) only in complicated acute appendicitis.

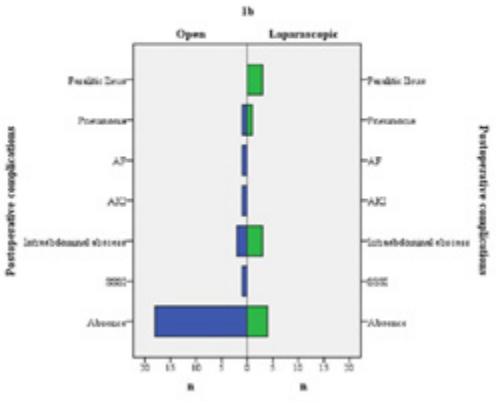
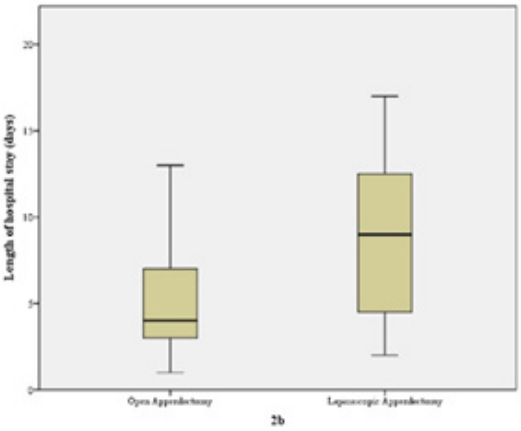


Figure 2b. Length of hospital stay for laparoscopic appendectomy (LA) and open appendectomy (OA) only in complicated acute appendicitis.



7. Discussion

Although AA remains the most common cause of acute abdominal pain in the younger population, its prevalence is increasing in elderly populations, particularly in developed countries. Given the high frailty in this population, there is a trend towards minimizing surgical trauma through the adoption of minimally invasive treatments. In our study, no significant differences were observed in terms of hospital stay, postoperative complications, and mortality between open and laparoscopic appendectomies in the elderly population. However, open appendectomy was more frequently preferred for preoperatively identified complicated AA cases. Additionally, among patients with complicated acute appendicitis, OA demonstrated superiority over LA in terms of operation duration, length of hospital stay, and postoperative complications. Meta-analyses have indicated prolonged hospital admission times in the elderly population with AA.6 This contrasts with a 50% decrease in hospital presentation rates for acute abdominal pain in the elderly compared to the younger population, owing to accompanying morbidities and delayed admissions to the emergency department.7 The increased rates of complicated AA due to accompanying

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morbidities and delayed admissions elevate the mortality rates to around 8% in this vulnerable population.8 Moreover, contamination resulting from perforation has been observed to lead to adverse outcomes in patients undergoing colorectal surgery.9 However, in our study, although the proportion of complicated cases was 52.2%, no mortality was observed. In a meta-analysis comparing outcomes of operative techniques in the elderly population with AA, LA demonstrated reduced postoperative morbidity and mortality, as well as shorter hospital stays, highlighting its safe applicability.5 Similarly, in complicated AA cases, laparoscopic surgery exhibited comparable postoperative complications to open techniques and could be safely applied in the elderly population.10 In our study, no superiority was observed between the two techniques regarding morbidity and mortality; however, laparoscopic cases showed prolonged anesthesia duration due to surgery. Nevertheless, in complicated AA cases, laparoscopic technique led to extended hospital stays and increased postoperative complications. Consequently, interventional drainage and prolonged antibiotic use prolonged hospital stays. Consistent with the literature, intra-abdominal abscess was the most common complication. Another point supported by the literature is the longer duration of surgery in laparoscopic techniques. 11 Although World Society of Emergency Surgery (WSES) guidelines recommend laparoscopic techniques for the elderly population, many centers still perform complicated AA using open techniques.12-14 Therefore, open techniques are associated with relatively increased postoperative complications and mortality, prolonged operation times, and extended hospital stays, akin to the Will Rogers phenomenon.

Table 2: Outcomes of demographic data and preoperative findings of laparoscopic and open appendectomy

Variables		**Open Apendectomy(n=33)**		**LaparascopicApendectomy(n=34)**		
		n(%)	Median (min-max)	N(%)	Median (min-max)	p-value
Gender	Male	18(54.5%)		15(44.1%)		0.393
	Female	15(45.5%)		19(55.9%)		
Age (years)			72(65-92)		69(65-90)	0.222
ASA	1	0(0%)		4(11.8%)		0.112
	2	20(60.6%)		20(58.8%)		
	3	13(39.4%)		10(29.4%)		
CAD		9(27.3%)		4(11.8%)		0.109
COPD		8(24.2%)		3(8.8%)		0.089
DM		8(24.2%)		11(32.4%)		0.462
HT		23(69.7%)		21(61.8%)		0.494
ED arrival time (days)			3(1-7)		2.5(1-10)	0.258
WBC (mm3)			12.4(2.6-27.7)		12.2(5-24.4)	0.74
CRP (mg/dL)			8.9(0.1-18.5)		4.65(0.3-40.2)	0.31
Diameter (mm)			10(5-40)		10(5-26)	0.231
Complicated		24(72.7%)		11(32.4%)		0.001
Operation Time (minute)			55(25-150)		70(30-120)	0.007
Drain		22(66.7%)		8(23.5%)		<0.001
DrainTime (days)			3(0-12)		0(0-17)	0.005
PostoperativeComplication	Absence	25(75.8%)		26(76.5%)		0.461
	SSSI	1(3%)		0(0%)		
	Intraabdominalabscess	2(6.1%)		4(11.8%)		
	AKI	1(3%)		0(0%)		
	AF	2(6.1%)		0(0%)		
	Pneumonia	1(3%)		1(2.9%)		
	Paralitic İleus	1(3%)		3(8.8%)		
Length of hospitalstay (days)			4(1-13)		3(1-17)	0.238

Min: Minimum; Max: Maximum; ASA: American Society of Anes the siologists; CAD: Coronary Artery Disease; COPD: chronic obstructive pulmonary disease; DM: Diabetes Mellitus; HT: Hypertension; ED: Emergency Department; WBC: White blood cells; CRP: C-reactive protein. SSSI: Superficial surgical site infection; AKI: Acute Kidney Injury; AF: atrial fibrillation. Statistically Significant Results ($p<0.05$) were written in bold format.

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Table 3: Outcomes of open and laparoscopic appendectomy in complicated acute appendicitis

Variables		ComplicatedAcuteApandisitis				
		O. Apendectomy (n=24)		Lap. Apendectomy (n=11)		
		Median (min-max)	n(%)	Median (min-max)	n(%)	p-value
Length of hospitalstay (days)		4(1-13)		9(2-17)		0.027
Operation Time (minute)		60(40-150)		80(70-120)		0.033
Postoperative Complication	Absence		18(75%)		4(36.4%)	0.04
	SSSI		1(4.2%)		0(0%)	
	Intraabdomi nalabscess		2(8.3%)		3(27.3%)	
	AKI		1(4.2%)		0(0%)	
	AF		1(4.2%)		0(0%)	
	Pneumonia		1(4.2%)		1(9.1%)	
	ParaliticİIeus		0(0%)		3(27.3%)	

Min: Minimum; Max: Maximum; SSSI: Superficial surgical site infection; AKI: Acute Kidney Injury; AF: Atrial fibrillation. Statistically Significant results ($p<0.05$) were written in bold format.

8. Conclusion

In elderly population, LA does not exhibit superiority over OA in terms of postoperative outcomes in AA. However, due to the better postoperative results of OA in complicated AA cases, we recommend open appendectomy for complicated AA in the elderly population.

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